A THEORETICAL AND EMPIRICAL ANALYSIS OF THE DETERMINATION OF
THE ALLOCATION RATIO IN STANDBY UNDERWRITTEN RIGHTS
OFFERINGS

by

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Dissertation submitted to the Faculty of the

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

General Business

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July, 1982
Blacksburg, Virginia

ACKNOWLEDGEMENTS

This dissertation could not have been attempted nor even completed without the assistance and support of a great many people.

I would like to gratefully acknowledge the teaching and guidance of the members of my advisory committee: Dr. Robert S. Hansen, Dr. David F. Scott, Jr., Dr. John M. Pinkerton, Dr. Walter L. Young, and Dr. Marvin Lentner.

I am especially indebted to Dr. Robert S. Hansen, my major advisor, who advised me on numerous academic and personal matters; was always encouraging and helpful when I had difficulties with the dissertation.

I must also express my gratitude to Dr. Walter L. Young, Dr. John M. Pinkerton and the patient consultants at the computing center. Without their assistance, the empirical part of the dissertation could not have been done in time.

I would also like to thank Dr. John J. Thather for his warm concern during the hard time and the constructive criticism he made about the dissertation.

To my parents, I must express my gratitude and love for their endless love and sacrifice in bringing me up and offering me an excellent environment for growing.

Last but not least, I would like to express my special love and affection for my husband for his loving support during the difficult times and sharing of the good times.

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Chapter I

STATEMENT OF THE PROBLEM

The standby underwritten rights offering has long been practiced by companies as one way to raise equity capital. Typically, these firms contract with an investment banker for advice associated with the issue as well as for the guarantee of sales of any securities not distributed through current shareholders. Among the decisions to be made during contract negotiations is the determination of the issue price (or equivalently, the allocation ratio) at which the new shares will be sold. This decision is among the most crucial factors for the success of the issue, and its effect upon shareholders' wealth has been an issue of much dispute in the finance literature. Basically, the arguments around the subscription price decision focus upon resolving the question: Is the subscription price decision irrelevant, or, is there an optimal issue price?

The irrelevance school of issue price argues that the subscription price is irrelevant in that the issue price has no effect upon current shareholders' wealth. To support this argument the logic is offered that as long as the rights are

exercised or sold by shareholders they will not incur any change in wealth because they recover a value equivalent to the decline in the ex-right value of shares. The irrelevant school argues further that because the level of the issue price does not affect owners wealth, it can be set sufficiently low for the risk of undersubscription to be virtually eliminated, thereby rendering the underwriting function unnecessary. This view is advanced by Merrett, Howe and Newbould [32], it is supported by both Smith [39] and Marsh [30], and reiterated by Brealy and Myers [10]. However, there are some factors which the irrelevance theory fails to take account of, for example, the transaction costs involved in rights offerings.

The relevance school of issue price argues that issue price does matter and that there is an optimal price which will maximize shareholder's wealth. Beranek [11], Jones-Lee [22], and Levy and Sarnat [24] all refute the notion that issue price is irrelevant. Beranek argues that the existence of costs of transferring the firms' stock provides one reason why the issue price can not be set arbitrarily low: a low issue price implies a larger number of shares issued, which results in higher costs for transferring share titles. According to Beranek, therefore, there is an optimal subscription price below which excess transfer costs are incur-

red [11]. Jones-Lee reasons that the issuer faces an economic trade-off between the maximization of increase in shareholders' wealth by increasing the issue price and the minimization of the risk of undersubscription by decreasing the issue price. Thus, according to Jones-Lee, an optimal subscription price exists, one that equates at the margin the benefits of increased owner wealth and the costs of undersubscription risk [22]. Levy and Sarnat recognize that the cost of undersubscription, hence the cost of underwriting, should decrease as issue price is lowered, however, they also argue that the resulting change in the firm's dividend policy will introduce increasing cost as more shares are issued. Thus, an interior optimal issue price is that price which minimizes the total of these costs [24].

There are three completely ignored factors in the standby rights literature which are introduced in this dissertation and which, it will be argued, are central to optimal underwriting decisions. First is the explicit consideration of distribution costs by the firm as well as by the underwriter. Just as for any wholesaler or retailer, the investment banker must incur marketing costs in order to distribute the product: securities. According to Hayes [20], the most important determinant for advancing within the hierachy of the underwriting industry is the investment banker's distribu-

tion capability. An effective distribution system requires the incurrence of fixed costs for branch offices, communications systems, stock distribution networks, and back office facilities. Because of the resulting cost economies, underwriters depend on high levels of product flow-through. In addition to these fixed costs, there are additional variable distribution costs incurred as the shares are being merchandized. The importance of distribution costs is made evident by Hayes, when he states [20, p.137]: "A typical breakdown of the gross spread on a debt issue would show 20% for the managing underwriter, 30% to the underwriting group for assuming the placement risk, and 50% for the selling concession to those firms that assume the task of distributing the issue." A cost minimization model of optimal issue price is not complete without taking into account these distribution costs. In Mandelker and Raviv's [27] paper on optimal underwriting contracts, however, the effect of distribution cost is assumed away by postulating that the distribution cost of issuers and underwriters are independent of (hence irrelevant to) the underwriting contract.

Second, the distribution function and the insurance function that the investment banker performs are two different functions which should not be mixed together when one studies the costs of underwriting. This distinction between

the fee for underwriting and the fee for distributing is
best illustrated by a typical two-fee underwriting contract
in which the underwriter receives an initial standby fee for
underwriting as well as other fixed expenses associated with
the syndicate, plus a contingent take-up fee for selling any
unsubscribed shares. Even in the case of a single fee con-
tract, however, the role of the underwriting function and
the role of the distribution function are each very distinct
and they should not be treated indiscriminately.

A third factor that has been ignored in previous analyses
of rights offerings is the role of owner's subscription
costs. In addition to the costs incurred by the firm and
the syndicate, current owners in a rights offering also in-
cur expenses. Exercising or selling rights, for example,
involves liquidity costs and brokerage fees. Other costs
might include the time expended by owners as well as expens-
es incurred for readjusting the investment portfolio.

The purpose of this study is to examine the decision by
firms to set the allocation ratio, hence the subscription
price, when the firm contracts with investment bankers to
underwrite a rights offering, on a standby basis, to raise a
fixed amount of new equity capital. The three factors noted
above which are not taken into consideration in the existing
literature, will be analyzed within a theoretical model of

the allcation ratio. In addition, the study will present an econometric model to test the empirical implicaitons of the model and to test the alternate, but not competing, theories of Beranek's transferring costs hypothesis and Levy and Sarnat's dividend cost hypothesis.

Chapter II

A REVIEW OF THE VALUATION OF RIGHTS AND THEORIES
OF SUBSCRIPTION PRICE

In this chapter a general description of the definitions,
procedures and characteristics of a rights offering is in-
troduced first, followed by a review of the mathematics with
respect to rights valuation. Beginning with Section 2.5
factors influencing the success and the significance of sub-
scription price are examined. Next, the arguments for and
against the relevancy of issue price in the current litera-
ture are summarized. Finally, to serve as a bridge between
theroies and reality, empirical studies on the price behav-
ior of stock issues are discussed.

2.1   RIGHTS OFFERINGS: DEFINITIONS AND OVERVIEW

In a rights offering, current stockholders are given the
first opportunity to subscribe to new shares on a pro rata
basis. Each share owned by existing shareholders is enti-
tled to one right. The right is an option to purchase stock
at a fixed price (i.e., the issue price or the subscription
price) and it must be exercised within a certain period of

time, usually two to three weeks. The number of rights
needed to purchase a new share is called the allocation ra-
tio or the subscription ratio, which is equal to the ratio
of old shares to new shares.

Since the issue price is usually set at a discount below
the current market price of stock, rights generally have va-
lue and can be traded in the market during the subscription
period. A stockholder may sell any rights that he or she
does not plan to use through the market mechanism or through
the firm's subscription agent. There are also some inve-
stors who, instead of selling or exercising the rights, sim-
ply do nothing and let the rights expire. For some issues,
unexercised rights can be reoffered through an oversubscrip-
tion privilege to subscribing shareholders, otherwise they
are sold to the underwriters.

J. B. Williams in his finance classic describes rights
offerings as such [42, p. 63]:

> Like stock dividend, an offering of rights, in so
> far as it increases the number of shares outstand-
> ing, but leaves unchanged the percentage owned by
> each stockholder, adds nothing to the value of the
> stockholder's equity. And in so far as the offer-
> ing brings new money into the company, it is like
> any other assessment in building up the stockhold-
> er's equity. But in so far as the offering draws
> this money out of strockholder's pocket, it in-
> creases the total cost of his commitment.

Operationally, therefore, a rights issue may be viewed as the opposite of a cash dividend. It is said that the payment of a cash dividend reduces the value of the stockholder's investment and increases the value of their bank account, while the exercise of rights does just the reverse. "Rights and dividends are opposite aspects of the same thing, differing only with respect to the direction in which the money flows. In effect, company is taking back with one hand what it doles out with the other." [42, p. 64]

2.2   UNDERWRITTEN RIGHTS OFFERINGS

There are several forms of underwriting contracts; the major ones are the "firm commitment" contract, the "best effort" contract, and the "standby" contract.

In a firm commitment contract, the underwriter purchases the entire issue outright and bears all the risk of adverse price fluctuations as well as the cost of distributing the new shares. In a best efforts contract, the investment banker acts only as a marketing agent for the issuer and all the risk associated with the issue is borne by the issuer. For a standby rights offering, the firm contracts with an investment banker who agrees to buy any unsubscribed shares,

hence in this form of underwriting the risk and distribution cost is shared by the issuer and the investment banker. From the above description, one can see that underwriters may either perform the insurance function, offering some protection to existing shareholders against the decline in share prices during the rights issue, or take up only the distribution function in the process of offerings; and in some cases, the two functions may be combined.

Underwriting compensation for standby agreements is typically computed in two ways: the single-fee arrangement or the two-fee schedule. In the single-fee contract, the underwriter is paid one basic fee for all shares and, therefore, this contract closely resembles the firm commitment fee schedule. In a two-fee contract, the underwriter receives an initial basic standby fee, plus an extra contingent take-up fee for selling any unsubscribed shares. In general, the standby expense contains a fee for underwriting, payments for advice associated with the issue, expenses for the legal obligations of the underwriting syndicate in connection with the prospectus, and any other expenses incurred in the formation and maintenance of the syndicate. The take-up fee may be a flat fee or a proportional fee [27,28,30,39].

An example of the time schedule for the procedure of rights offering is shown in Table 1. In addition, Table 1 also shows how the stock is "divided" on the ex rights date into two parts: the stock ex rights and the rights.

TABLE 1

A Timetable of The Rights Offering

	Time from the issue date	Event
STOCK TRADES RIGHTS-ON	- 3 weeks	Underwriting syndicate organized, registration statement filed, Red herring prospectus distributed.
	- 2 weeks	SEC deficiency corrected, registration becomes effective, offering is announced, begin trading of rights.
	- 1 day	Final terms established, issue price specified.
	0	The issue date, rights mailed to stockholders.
STOCK TRADES EX-RIGHTS	+ 1 day	The ex-rights date.
	+ 2 weeks	Expiration date.
	+ 3 weeks	Closing date, final settlement with the underwriter, receive proceeds of the sale net of underwriting fees.

2.3 RIGHTS VALUATION

In this section, the theoretical relationships among the value of a right, the subscription price and the allocation ratio are examined. In addition, the theoretical effect of the rights offerings on shareholders' wealth and the inherent stock split effect of the rights offering are analyzed. Finally, an alternate option pricing approach to rights valuation is illustrated.

2.3.1 Traditional Formula

Let us define the following variables:

R = the theorectical market value of a right

$V = n_0 P_0$ = the market value of existing equity

n_0 = the number of old shares outstanding

n_1 = the number of new shares

P_0 = the market price of a share, rights-on

P_1 = the theoretical value of the ex-rights stock price

P_S = the subscription price

$I = n_1 P_S$ = the value of new funds to be raised

$N = n_0 / n_1$ = the allocation ratio, the number of old shares required to purchase one new share

SE = the inherent stock split

v = the percentage of new shares subscribed by current owners, for simplicity, we assume $v = 1$ at this stage.

2.3.1.1   The theoretical value of the stock ex-rights

There are two identity equations in rights offerings. Firstly, by value preservation, the value of old equity plus new investment capital equals the ex-rights value of equity;

$$n_0 P_0 + n_1 P_S = P_1 (n_0 + n_1) \qquad (1)$$

Solving for P_1, the theroetical value of the stock ex-rights is:

$$P_1 = (N P_0 + P_S)/(N + 1) \qquad (2)$$

2.3.1.2   The theoretical value of rights

Secondly, arbitrage will force into equality the outlay of the following two alternatives: (1) buying a stock ex-rights, or (2) buying a stock through the exercise of rights:

$$P_1 = P_S + NR \qquad (3)$$

Substituting (2) into (3), and solving for R

$$R = (P_0 - P_S)/(N+1) \qquad (4)$$

Alternatively, if we substitute P_0 in (2) into (4) we obtain

$$R = (P_1 - P_S)/N \qquad (5)$$

Thus

$$\partial R/\partial P_1 > 0$$

That is, ceterus paribus, the value of a right increases as the ex-rights market price of the stock increases. Finally, the value of a right can be shown to be the difference between the price of stock rights-on and rights-off by substituting (3) into (4) and solving for R

$$R = P_0 - P_1 \tag{6}$$

2.3.1.3 The effect of rights on owners

Equation (6) states that old shareholders can, by selling rights, recover a value equivalent to the decline in the value of shares. It is worth emphasizing that, theoretically, as long as the rights are exercised or sold, shareholders will not incur any loss in wealth. As indicated above, by selling rights shareholders reduce their investment in the firm, but they are compensated by the value of the rights. If they choose to exercise the rights, the loss due to a decrease in stock price will be offset by the gain from purchasing new shares at the lower than market subscription price. That is:

$$n_1(P_1 - P_S) = n_0(P_0 - P_1) \tag{7}$$

The expression on the left hand side is the gain from a cheaper subscription price, the expression on the right hand side is the loss from a decline in stock price; the equality must hold by equation (1).

In addition to exercising or selling all of the rights entitled to them, shareholders can sell part of the rights and use the proceeds to subscribe to the remaining rights, thereby keeping their investment intact. The proportion of rights to be subscribed in this case , q, is given in equation (8):

$$(1 - q)n_1 R = qn_1 P_S \qquad\qquad (8)$$

hence

$$q = R/(R+P_S)$$

where q is the proportion of rights to be subscribed to keep the initial level of the investment unchanged. The right hand side of equation (8) is the proceeds from selling (1-q) percent of rights, and the left hand side is the amount paid to subscribe to the remaining rights.

2.3.1.4   The relationship between the allocation ratio and the issue price

It is easy to show that the allocation ratio and the subscription price are positively related for a given amount of funds:

$$P_S = I/n_1 = n_0 I/n_0 n_1 = NI/n_0 \qquad (9)$$

Thus

$$\partial P_S / \partial N > 0$$

That is, the value of the issue price increases directly with the allocation ratio.

Note that the only assumption of the above rights formula is that the value of the right depends on the market price of stock. It makes no assumptions concerning earnings or dividends. The market price of the stock has reflected any anticipated change in earnings or dividends as a result of the investment of funds raised [1,11,15]. Of course, the actual value of a right may differ from its theoretical value due to transaction costs, speculation, and the supply and demand of rights over the subscription period.

2.3.2   The Inherent Stock Split Effect of Rights Offerings

It is widely observed that the rights offering has quasi-split characteristics [8,13,24,35]. As Levy and Sarnat [24, p. 841] put it, "a rights offering is like a stock dividend to existing shareholders, coupled with a new stock issue to which these shareholders have first right to subscribe." The discount in issue price and the allocation ratio determine the degree of the inherent stock split effect. There are two ways to express the stock split effect of a rights offering. Dipchand [13] derived a term for the stock split from the viewpoint of the relative increase in the number of shares in a rights issue, while Levy and Sarnat [24] expressed the split effect from the viewpoint of changes (decreases) in prices. Both expresions are presented as follows:

Let $D = (P_0 - P_S) / P_0$ = the price discount, and

   $W = I / V$ = the proportion of new funds raised relative to the existing equity.

Then, based on the relative increase in the number of shares, the split can be expressed in terms of the price discount and the proportion of new funds raised relative to old equity,

$$SE = [(I / P_S) - (I / P_0)] / [(I + V)/ P_0]$$

$$= [D / (1 - D)] [W / (1 + W)]$$

From the relationship between the pre- and post-offering prices, the alternate expression for the split element can be derived:

$$P_1 = P_0 / (1 + SE)$$

or

$$SE = (P_0 - P_1) / P_1$$
$$= R / P_1$$

The two expressions for the stock split effect can be shown to be identical ,hence

$$SE = [D / (1 - D)] [W / (1 + W)] \qquad (10)$$
$$SE = R / P_1$$

Figure 1 gives a graphic presentation of the theoretical behavior of the stock price around the offer date, implied in the above discussion. On the ex-rights date, the price of stock falls from P_0 to P_1 , which is exactly the value of one right. However, if the market price of the stock(P_{1M}) falls below the subscription price, the actual value of a right becomes zero.

PRICE PER SHARE

P_0

$R = P_0 - P_1$

P_1

NR

P_S

P_{1M}

TIME
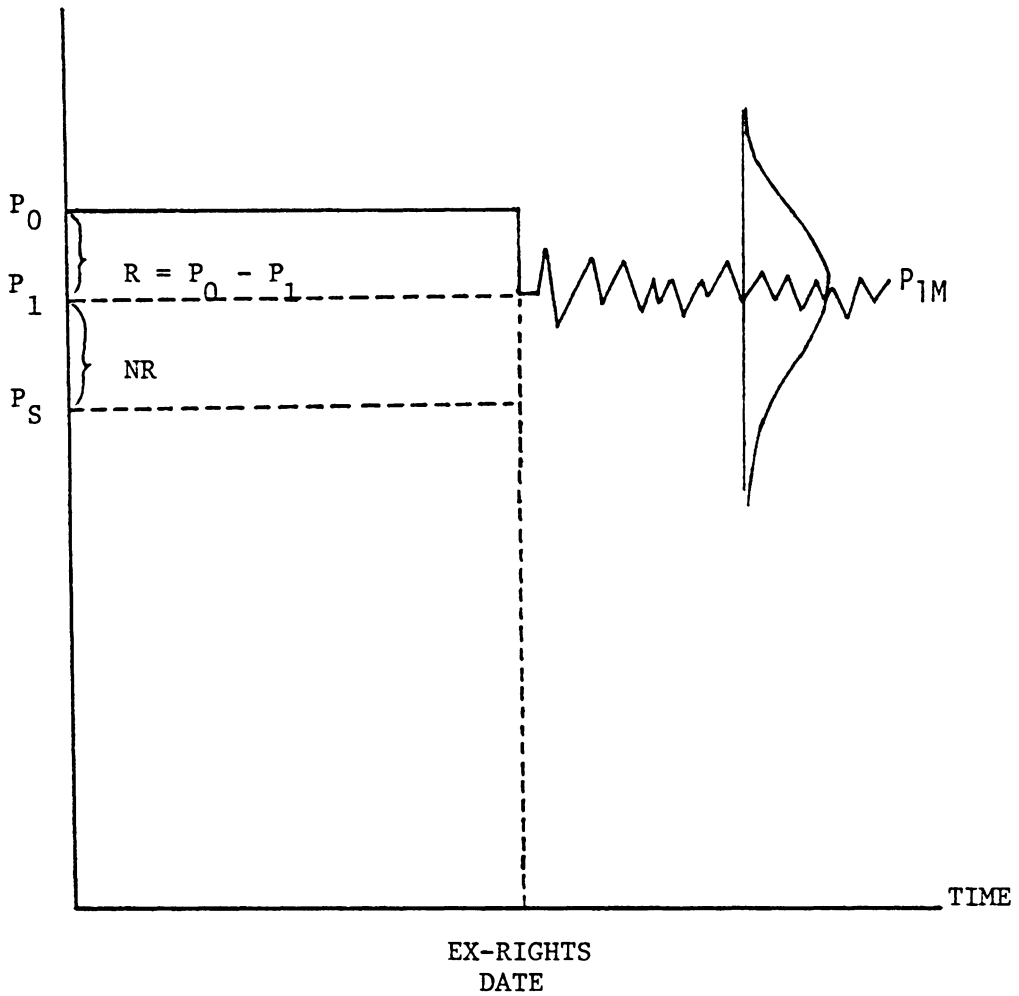
EX-RIGHTS
DATE

Figure 1: The Theoretical Behavior of the Stock Price

2.3.3 The Option Pricing Model and Rights Valuation

From the shareholder's viewpoint, a rights offer is a call option to buy stock. From the underwriter's viewpoint, the rights offering is like selling a put to the firm, with an exercise price equal to the subscription price. Thus, the rights offering may be perceived as a combination of these options.

Smith [39] employs the Black-Scholes option pricing model to derive the equilibrium value for the rights issue under the standard assumptions plus: (1) the only liabilities issued by the firm are its common stock and the rights, and (2) any assets acquired with the proceeds of the rights issue are acquired at competitive prices. The latter assumption is necessary to aviod the problem of the dependence of the dynamic behavior of the stock price on the probability of the rights being exercised.

Let X = the total proceeds resulting from the exercise of the rights, $X = P_S n_1$,

T = the time until the expiration of the rights,

s = the fraction of shares sold through the offering to total shares outstanding, $s = 1/(N+1)$,

V^* = the value of the firm's asset at the expiration date, $V^* = P_1 (n_0 + n_1)$,

R^* = the total value of the rights at the expiration date, $R^* = n_0 R$,

V = the current value of the firm, $V = n_0 P_0$.

At the expiration date, the value of the rights, R*, will be either zero or their fractional claim on the total assets of the firm, s(V* + X), minus the subscription payment, X:

R* = Max [0, s(V* +X) - X] = Max [0, sV* - (1 - s)X]

Invoking the Black-Scholes [7] option pricing formula, the final solution to this problem is

$$R = sVN(d_1) - e^{-rT}(1 - s)XN(d_2) = R(V,T,X,s,\sigma^2,r) \qquad (11)$$

where $N(d_1)$, $N(d_2)$ is the cumulative standard normal probability function; and

$$d_1 = \{\ln[sV/(1 - s)X] + (r + \sigma^2/2)T \}/ \sigma\sqrt{T}$$

$$d_2 = \{\ln[sV/(1 - s)X] + (r - \sigma^2/2)T \}/ \sigma\sqrt{T}$$

$\partial R/\partial V$, $\partial R/\partial T$, $\partial R/\partial s$, $\partial R/\partial \sigma^2$, $\partial R/\partial r > 0$, and $\partial R/\partial X < 0$

Furthermore, equation (11) can be restated as:

$$n_0 R = [1/(N+1)]P_0 n_0 N(d_1) - e^{-rT}[N/(N+1)]P_S n_1 N(d_2)$$

$$= n_0[P_0 N(d_1) - e^{-rT}P_S N(d_2)]/(N+1)$$

or,

$$R = [P_0 N(d_1) - e^{-rT}P_S N(d_2)]/(N+1) \qquad (12)$$

Note that when T = 0, equation (11) collapses to the previous result

$$R = (P_0 - P_S)/(N+1),$$

which is the value of the right when exercised. Note also that the value of a right exceeds its cash-in value for T > 0 and $N(d_1) = N(d_2) = 1$ (i.e., before expiration and under all possibilities),

$$R = (P_0 - e^{-rT} P_S)/(N+1) \quad > \quad (P_0 - P_S)/(N+1) \tag{13}$$

which is the value of the right in the market. Accordingly, rights should never be exercised before expiration; rather, it pays to sell them in the market. Equation (13) can be rewritten as

$$R = (P_0 - P_S)/(N+1) + (1 - e^{-rT}) P_S/(N+1) \tag{14}$$

That is, the market value of a right is the value of the right when exercised, plus a premium which increases as the time to expiration increases.

From Section 2.3, we know that the subscription price, or issue price, has important bearing on the value of the right. We will now turn the discussion into the interesting area of subscription price.

2.4   THE SIGNIFICANCE OF THE SUBSCRIPTION PRICE DECISION

This section focuses on the central issue of the significance of the subscription price, or equivalently, the significance of the allocation ratio. A review of the different arguments for and against the relevance of the issue price decision is presented and empirical studies of interest are summarized.

2.4.1   Factors Influencing the Success of Rights Issues: A General Discussion

There are many factors which might have a bearing on the success of a rights issue. The more important ones are summarized and briefly discussed to serve as a prelude to the theme of this section.

2.4.1.1   The subscription price

The subscription price is crucial to the success of the issue. This price must be sufficiently attractive to induce the public to go to the trouble of subscribing to the issue. It has been argued that the risk of undersubscription is directly related to the issue price; i.e., the higher the issue price, the larger the probability that the market price will fall below the issue price and, hence, the larger is the probability of undersubscription [2,24,41].

Bacon [2] has found a statistically significant, positive correlation between the ex post subscription rate and the discount in issue price; however, the explained variation is relatively low at 12 percent and this suggests the existence of other factors that will explain the ex post rate of subscription. In a second study, Dipchand [13] tests the correlation between the subscription discount and the subscription rate for Canadian rights offerings, but his data failed to exhibit a significant relationship between these two magnitudes.

On the other hand, the greater is the discount in the issue price, the greater is the dilution in earnings per share, EPS. Like a stock split, there is a dilution effect in a rights issue, where shares are normally sold at a discount. Due to the lower subscription price, firms adopting a rights offering may need to issue more shares than they do for public offerings, which leads to a greater dilution effect in EPS. Significant underpricing may excessively dampen the growth trend in EPS and result in lower P/E ratio which, in turn, may have an adverse effect on the subscription rate. Furthermore, it is said that underpricing will increase the total amount of dividends the company will need to pay to maintain its nominal dividend, and thereby lower its coverage ratio [41]. Finally, a larger discount also

means an increase in the total number of share traded, which in turn will cause higher trading and administrative expenses for the movement of any level of common stock value through public trades [11,24].

2.4.1.2   Other factors

In addition to the issue price, the size of the capital outlay may also affect the success of a rights offering: Large offers may face higher price pressure, which in turn could hinder the willingness of investors to subscribe [29,41]. However, there is no direct empirical evidence to support this hypothesis. Marsh [29], Bacon [2], and Scholes [38] have all studied the relationship between the size of the issue and the price performance after the offering. They found no significant abnormal returns exist during the post-issue period. In addition, Stoll [40] has studied the relationship between the issue size and the pre-offering price performance for underwritten issues of common stocks, including both firm offerings and rights offerings, and he found no consistent relationship. These results may be viewed as indirect evidence against the hypothesis that issue size affects the success of rights offerings.

Other factors such as the mix of existing shareholders (e.g., institutional vs. individual investor), the stability and/or trend of the market, the size of company, and the sector of industry may all have some influence on the success of the issue [41]. For instance, if the distribution of ownership is more concentrated, the probability of success in a rights issue may be higher. Hansen and Pinkerton [19] find that companies adopting a non-underwritten rights offering tend to have higher concentration of ownership. If the market trend is upward sloping and relatively stable, the probability of success may also be higher. Marsh [30] finds the pre-issue market performance is inversely related to the excess return earned by the subunderwriters in rights offerings in the U.K.; however, there is no direct test on the relationship between pre-issue market performance and the rate of subscription.

The basic question behind all these arguments lies in the relevance of the issue price in rights offerings. Does issue price matter? That is, is there an issue price that will maximize the wealth of the shareholder? To put it another way, can firms set the issue price arbitrarily low so that the risk of undersubscription is eliminated, thereby making underwriting unnecessary?

The following sections are devoted to an examination of
different opinions about the significance of the issue
price. While the arguments and corresponding evidence are
mixed and inconclusive, they are divided into three catego-
ries: the irrelevance school, the relevance school and the
middle-of-the-roader school.

2.4.2   The Irrelevance School of Issue Price

This school argues that the inherent logic of a rights
issue makes the issue price totally irrelevant; that the is-
sue price has no effect upon current shareholders' wealth
and it can therefore be set sufficiently low for the risk of
undersubscription to be virtually eliminated and underwrit-
ing rendered redundant. Alternately stated, the irrelevance
school argues that there is no unique optimal issue price.

2.4.2.1   Arguments of irrelevancy

Basically, the arguments of irrelevancy are:

1. Rights offer protection against subscription dis-
    count. The value of a right increases as the issue
    price decreases. It has been shown by equation (5)

that the value of a right exactly compensates for the decreasing ex-rights value of stock. Existing share-holders can, by selling rights, recover a value equivalent to the decline in the value of a share. Therefore, the issue price can be set arbitrarily low without influencing shareholders' wealth.

2. Innocuous dilution. In much the same way as a stock split, the decreased value of the stock is just off-set by the increase in the number of shares. There is no real dilution in shareholder's wealth [2,11]. Therefore, as long as the issue price is less than the market price, shareholders will be equally well off irrespective of the discount in issue price.

In theory, rights offerings make the shareholder neither better off nor worse off, as long as the rights do not expire unexercised or unsold. This was shown above in section 2.3.1. The shareholder can always sell the appropriate number of rights so that his or her original total investment value is unchanged (though in doing so, the percentage ownership of the firm is reduced). In short, the rights exist as a protection to shareholders, the full subscriber as well as the non-subscriber, from the dilution of their investment and wealth [9,10,28,36]. Brealey and Myers in Principles of Corporate Finance conclude that issue price is irrelevant as long as the right is exercised [10, p. 306]:

It is not surprising that the issue price is ir-
relevant in a rights offering. After all, it can
not affect the real plant and equipment owned by
the company, or the proportion of these assets to
which each shareholder is entitled. Therefore the
only thing a firm ought to worry about in setting
the term of a rights issue is the possibility that
stock price will fall below the issue price....can
avoid the danger(of undersubscription) by arrang-
ing a standby agreement with the underwriters.

S. M. Keane [23] also advances the view that the number
of rights issued, and inversely the issue price, can not af-
fect the market value of total ex-rights equity capital,
just as the number of stocks issued can not affect the mark-
et value of company's equity (apart from marketability).
Issue price becomes significant only if there is a conflict
of interests between the pre-rights shares and the new
shares; that is, when existing shareholders have to bear the
entire loss due to decline in the total market value of ex-
rights equity. In the latter case, a high-issue-price/un-
derwriting strategey can transfer some of the loss to new
shares.

Keane derived the proportion of shares held to total is-
sued shares if the stockholders keep their investment intact
(by selling some rights and using the proceeds to subscribe
to the remaining rights), and demonstrated that the propor-
tion in equilibrium is a constant independent of the issue
price. Therefore, as long as the issue price is below the

ex-rights market price, the issue price and the number of
rights issued are irrelevant to the shareholder. While un-
derwriting represents an insurance premium (in addition to
the guarantee of the success of the issue) and offers some
protection to existing shareholders against a decline in
price, it is effective only if the market price falls below
the issue price. Hence, lowering subscription price suffi-
ciently eliminates the need for the underwriting function.

Merrett, Howe and Newbould expressed their view on the
irrelevance of issue price [32, p. 57]:

> The essential logic of rights issue is also such
> as to lead to the expectation that underwriting of
> the issue is unnecessary.

They argued that since the issue price can be fixed so that
it is impossible for the rights price to become negative,
companies which pay underwriting commission on a rights is-
sue are making an expensive ex gratia payment.

Graphically, the irrelevance of issue price is presented
in Figure 2.

2.4.2.2   Empirical evidence

According to the irrelevance arguments, one would hypoth-
esize that the subscription discount has no adverse effect
on market price performance ex-rights, and that there is no

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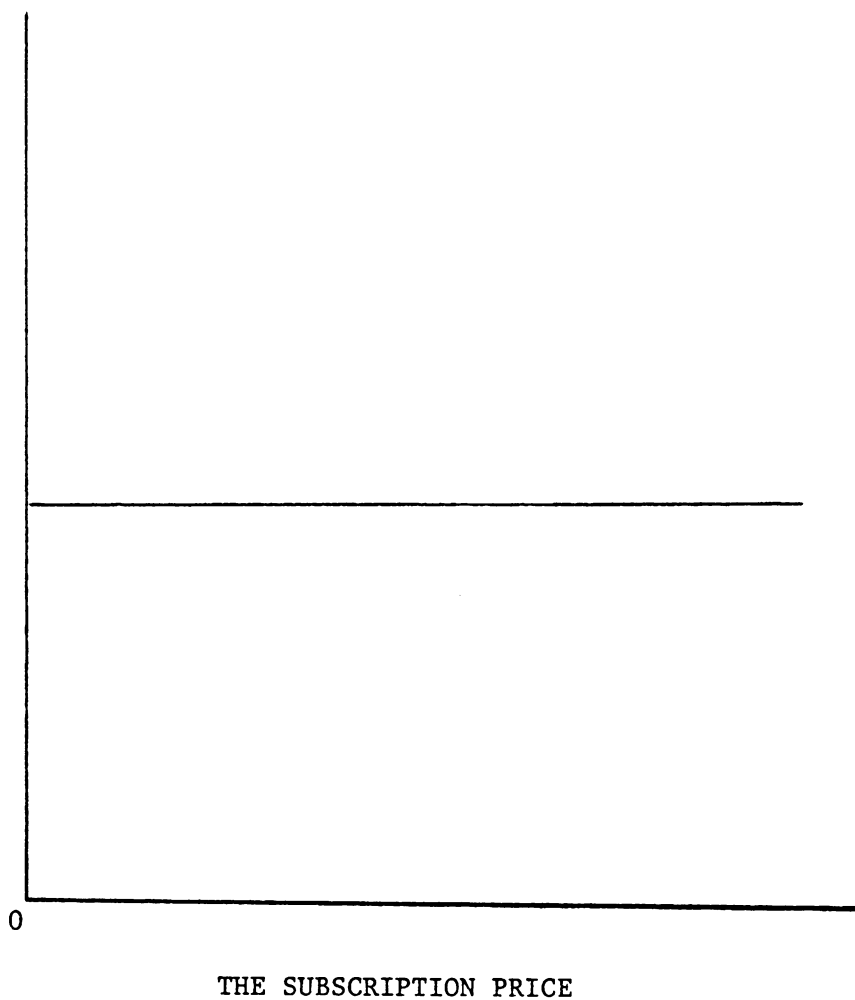
Figure 2: The Irrelevance of Issue Price

abnormal return post-issue. The results of empirical studies on this issue are not clear cut. Marsh [29] and Smith [39] both find some price pressure in the month of issue for rights offerings. Marsh finds a small positive abnormal return after the issue, while Smith finds on the average no abnormal return around the offer date, and he concludes that the wealth of the firm's owners is not reduced by a rights offering. Bacon [2] runs a regression of the subscription discount on the price performance ex-rights (which is measured in terms of the ratio of the weekly average price one month following the expiration date to the theoretical ex-rights price of the stock), and he finds no significant relationship between the two. However, when a linear regression is used to analyze the relationship between the inherent split effect and the price performance, it is found that the greater the split effect, the better the stock performs. One reason for the insignificant result of the former may be that the relative size of the issue discount does not fully represent the split effect in the offerings. As can be seen from equation (10), the split effect is a function of both the issue discount and the proportion of new funds raised relative to existing equity.

2.4.3   The Relevance School of Issue Price

This school argues that, in practice, issue price does matter and that there is an optimal subscription price which will maximize shareholders' wealth.

2.4.3.1   Arguments of relevancy

At least three arguments have been presented for the relevancy of the issue price; they are first summarized and then taken up in turn.

1. Dilution effect. The dilution effect in a rights offering is a significant cost to shareholders. A deep discount in the issue price will lower the growth trend in EPS which in turn will have an unfavorable impact on the market value of stock.

2. Expectation effect. Under the assumption that there is discrepancy between the decision-maker's and the market's expectation about the ex-rights price of stock, Jones-Lee [22] argues that the higher the issue price the higher the net increase in stockholder's wealth. On the other hand, the higher the issue price, the higher the probability of undersubscription. Without standby underwriting, the optimal issue price is that which can best balance the maximi-

zation of wealth and the minimization of the risk of undersubscription. With the use of underwriting, the optimal issue price is that which can balance the net increase in wealth against the cost of standby underwriting.

3. Indirect dividend cost hypothesis. There are two types of costs associated with a rights issue: the direct cost paid to the standby underwriters and the indirect cost inherent in the dividend component in a rights offering. While the direct cost increases as issue price increases, the indirect cost decreases as the issue price increases. The optimal issue price is that which minimizes the total costs of the rights offering.

Consider first the dilution effect argument. In theory, the fall in the stock price on the ex rights day simply reflects the value of the right which shareholders have been given, and the dilution in earnings per share due to the subscription discount is immaterial, since earnings per equity dollar are constant. However, many practioners argue that the relationship between the issue price and the market price may make a good deal of difference because of the per share earnings dilution effect [2], [39]. Historical earnings and dividends per share are not usually adjusted for

the quasi-split effect of the rights issue as is usually done in the case of a stock split. Since the lower is the issue price the higher is the quasi-split effect, then the greater will be the understatement of the growth rate in EPS. To the extent that the investment community values this growth trend in EPS, the market value of stock may be lower than it should be. Therefore, it has been suggested that the use of underwriters will raise stock prices while rights offerings lower them.

The second argument for the relevancy of issue price is attributed to Jones-Lee [22]. Jones-Lee developed his theory of issue price under the assumption that (i) the firm wants to maximize the wealth of the existing stockholders; and (ii) during the subscription period, there are lags in the dissemination of information concerning the new investments to be financed, and these lags lead to a discrepancy between the decision maker's and the market's expectations about the ex-rights price of stock (the latter being the lower.)

Jones-Lee [22] defines a variable Z, as the expected net increase in existing shareholders' wealth, which is equal to the ex-rights market value of the pre-issue holdings of current shareholders, plus the ex-rights market value of the shares subscribed to by the current shareholders, plus the

proceeds of the sale of rights by current shareholders, less the sum subscribed by current shareholders, less the pre-issue market value of current shareholders' pre-issue holdings. In other words, Z is defined as:

$$Z = E_a(vn_1 + n_0)/(n_0+n_1) + \{(1-v)n_1[\overline{E}_a/(n_0+n_1) - I/n_1]\}$$
$$- vI - E \qquad\qquad (15)$$

where E_a = the decision maker's expectation of the ex-rights

market value of all equity = $P_1(n_0+n_1)$

$\overline{E}_a$ = the market's expectation of the ex-rights

value of all equity = $P_{1M}(n_0+n_1)$

E_b = the market value of the equity pre-issue = $P_0 n_0$.

It can be shown that

$$\partial Z/\partial n_1 = n_0(1 - v)(\overline{E}_a - E_a)/(n_0 + n_1)^2$$

If $0 < v < 1$ and $E_a > \overline{E}_a$, hence the issue is undersubscribed and undervalued by owners,
then $\partial Z/\partial n_1 < 0$ and $\partial Z/\partial P_S > 0$.

If $v = 1$, or $E_a = \overline{E}_a$, so that owners fully subcribed or there is no market valuation asymmetries,
then $\partial Z/\partial n_1 = 0$ and $\partial Z/\partial P_S = 0$.

That is, in Jones-Lee's [22] expectational model of rights valuation, the issue price is irrelevant only under either of the following two conditions: (i) the market's expectation is equal to the decision maker's expectation about the ex-rights value of stock, or, (ii) the stockholders subscribe to all of their rights. As long as there are expectational asymmetries, the issue will be undervalued by owners; i.e., $\bar{E}_a < E_a$, and the net increase in wealth is directly related to the price of subscription. Furthermore, since

$$R = P_{1M} - P_S = \bar{E}_a / (n_0 + n_1) - I / n_1,$$

then the value of the rights is inversely related to the issue price

$$\partial R / \partial n_1 > 0, \quad \partial R / \partial P_S < 0.$$

Since the probability of undersubscription is inversely related to the value of a right, one must take into consideration the balance between maximizing expected wealth and minimizing risk upon setting the issue price. In the case of standby underwriting, assuming that the cost of underwriting increases with the risk of undersubscription, the optimal issue price is that which balances the expected net increase in wealth against the cost of underwriting. In sum, some

degree of underwriting will be optimal for the firm. A
graphic example of Jones-Lee's theory is presented in Figure
3.

The third argument of subscription price relevance is ad-
vanced by Levy and Sarnat [24] who develop a model for det-
ermining the optimal subscription price, hence optimal allo-
cation ratio. Approaching the problem from the standpoint of
minimizing total cost, Levy and Sarnat constructed two cost
functions with respect to rights offerings; a direct cost
function and an indirect cost function.

The direct costs are those associated with underwriting the
issue. The primary risk associated with the rights issue,
undersubscription, can be avoided by contracting with a
standby underwriter. Levy and Sarnat argue that the appro-
priate estimate of relevant market price decline must be
based upon the spread between the ex-rights theoretical
price and the issue price. They define a variable k, to be
the underwriter's "confidence limit," where

$$k = (P_1 - P_S) / P_1$$

Assuming the underwriter's risk is a monotonic declining
function of k, the total underwriter's costs can then be ex-
pressed as

$$Y(N) = a_0 + b_0 (1 / k) \qquad (16)$$

DOLLAR

COST OF
UNDERWRITING

EXPECTED INCREASE
IN WEALTH

0

P_S^*

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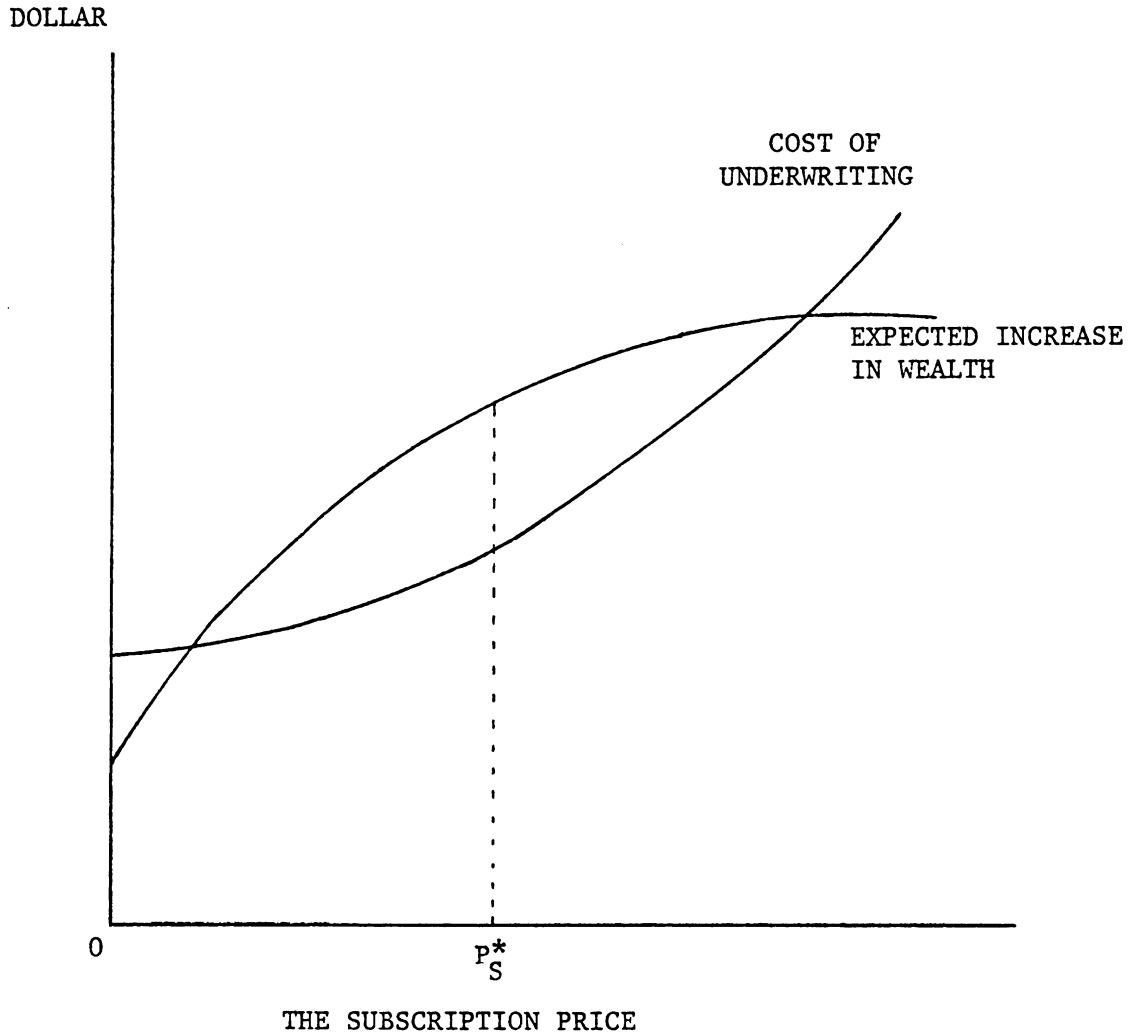
Figure 3:   Jones-Lee's Optimal Issue Price Model

where a_0 is the fixed cost of underwriting and b_0 is an insurance premium associated with the degree of risk.

Substituting equation (2) into k, and this expression for k into (16), and minimizing Y yields the problem

$$\text{Min}_N \ Y(N) = a_0 + b_0 [\ (NP_0 + P_S) \ / \ (NP_0 - NP_S) \ ]$$
$$\text{subject to} \quad I = (\ n_0 / \ N \ ) \ P_S$$

where, as before, N is the allocation ratio, n_0 is the number of old shares and I is the level of funds to be raised.

It is then easy to show that, for all levels of the allocation ratio,

$$\partial Y / \partial N > 0, \quad \text{hence} \quad \partial Y / \partial P_S > 0.$$

In other words, given the amount of new funds to be raised, the direct cost of the rights offering increases as the issue price or the allocation ratio increases. Now if there are no other costs associated with the offering the conclusion emerges, as in the irrelevance school, that the subscription price, hence allocation ratio should be minimized.

As noted, a rights offering has a quasi-split effect. The fall in the market value of an old share in a rights issue is equivalent to the fall in price induced by a given stock dividend. Shareholders can purchase R/P_1 additional

shares for each old share they owned prior to the rights issue without increasing their investment outlay. As was shown at equation (10), R/P_1, is the split effect which measures the stock dividend component implicit in a rights offering.

Levy and Sarnat argue that, while a small allocation ratio can minimize the cost of underwriting, it may imply too large an increase in future nominal cash dividends to maintain current per share dividends. They consider this effect as an indirect cost of a rights offering, and express this indirect cost as a function of the dividend component inherent in the rights issue:

$$D(N) = a_1 + b_1 (R / P_1) = a_1 + b_1 [R / (P_0 - R)]$$

if $b_1 > 0$, then

$$\partial D / \partial N < 0, \quad \text{and} \quad \partial D / \partial P_S < 0.$$

That is, given the amount of new funds, the indirect cost decreases as the issue price or the allocation ratio increases.

Let the rights offering total cost function be T(N),then

$$T(N) = Y(N) + D(N)$$

Finally, the optimal allocation ratio, N* (and thus the optimal issue price), is determined at the point where the total cost is minimized, and this occurs where the rising marginal cost of dilution just equals marginal cost of underwriting the issue. Figure 4 gives a graphic presentation of this model. The general argument of the relevance school of issue price is illustrated in Figure 5.

According to Modigliani and Miller's [34] theory, dividend policy is irrelevant to the firm's value. If a dividend payment is increased and is greater than the operating income, the firm can always raise additional external capital without influencing its investment policy. In other words, the value of the firm depends only on the distribution of future cash flows from investment, which is independent of the dividend policy. If M&M's theory is correct, the arguments of Levy and Sarnat will be invalidated. According to the signalling hypothesis, any changes in dividend payout can be interpreted as a new information about the future cash flows of the firm. Thus, an increase in dividend payout may result in an increase in stock price, but it is the message, rather than the dividend itself, that affects price. Thus, the underlying assumption the the Levy and Sarnat model is that the nominal level of the per share cash dividend matters.
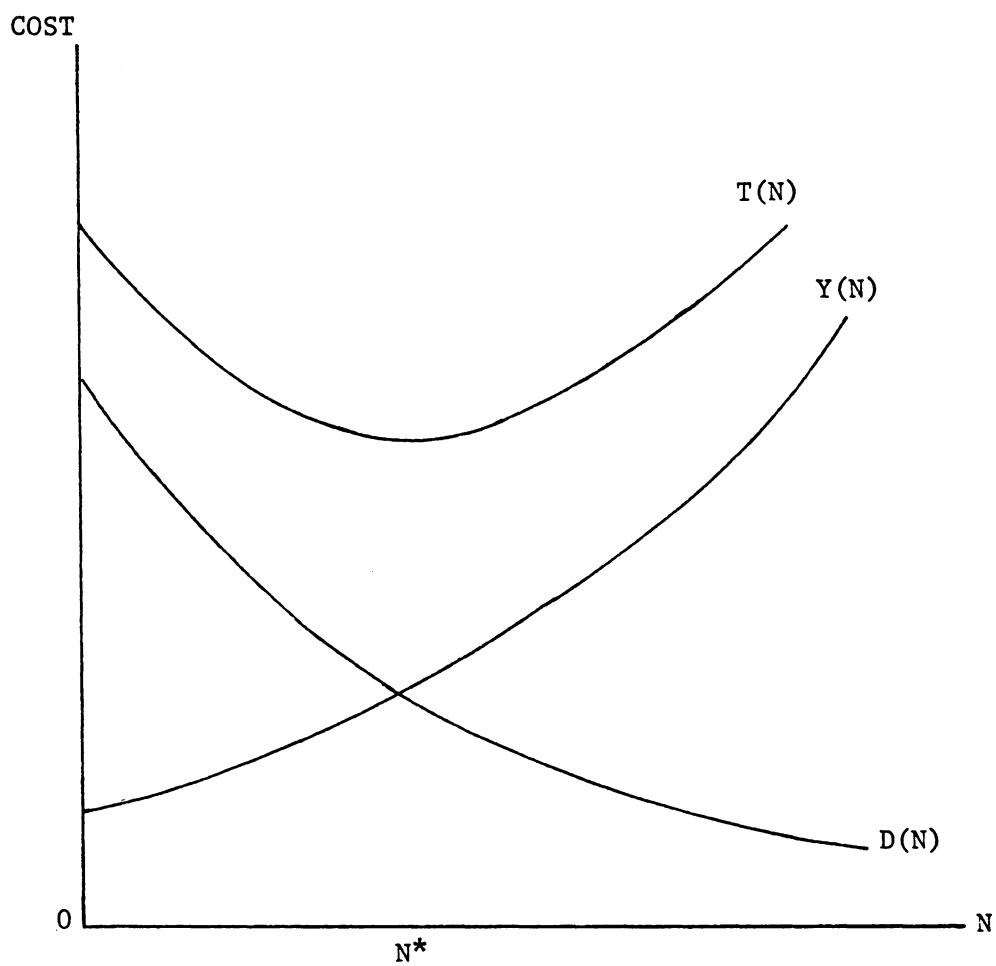
Figure 4: Levy and Sarnat's Model of Optimal Allocation Ratio

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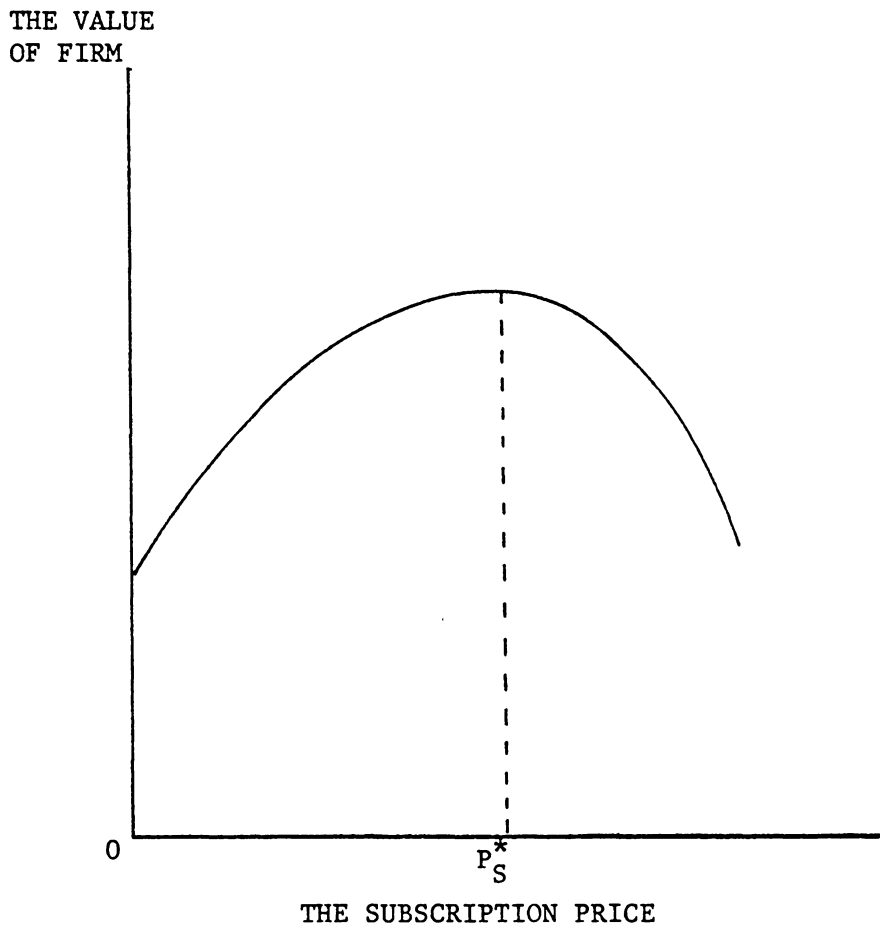
Figure 5:   The Relevance of Issue Price

2.4.3.2   Empirical evidence

The empirical evidence on dividend policy is mixed.
Black and Scholes [6] have empirically tested the relation-
ship between corporate dividend payout and the before-tax
return on common stock, their results do not support the hy-
pothesis that dividend policy impacts upon the value of
firms.

Nelson [35] tested the proposition that rights have split
effects similar to stock splits and stock dividends. His
data was consistent with this view. More importantly, his
data showed that market prices, adjusted both for split ef-
fect and a general market effect, increased (decreased) when
subsequent cash dividends were increased (decreased). His
finding is similar to that of Fama, Fisher, Jensen and
Roll's [17] test on stock splits. If the decrease in market
price in connection with a subsequent decrease in dividends
can be viewed as an indirect cost to firm, then Levy and
Sarnat's argument may be partly supported.

In Bacon's [2] study, it was found that the split effect
of the rights offering has positive influence on the average
price performance one month after the issue. However, his
study did not separate those firms which increased dividends
from those which decreased dividends after the distribution.
From the discussion in Section 2.4.1.1, the findings of a

positive relationship between the discount in issue price and the success of the issue does support part of Jones-Lee's analysis; however, the insignificant correlation between discount and price performance seems to weaken his argument on $\partial Z / \partial P_S > 0$.

2.4.4   The Middle-of-the-Roader

Instead of a unique optimal solution, Beranak [11] suggests that in the case of a rights offering, there is considerable latitude for setting a rational subscription price. Without a rights offering, there is one and only one subscription price, the highest attainable price.

The transaction cost and the cost of administering transfers of title to stocks are mentioned as factors which may put a limit to the lower bound of the issue price. Since the lower the issue price, the more are the shares needed in the offering; hence the larger will be the volume of trading in the firm's stock, which results in increasing administrative costs and increased transaction costs.

Graphically, the relationship between the issue price and the value of the firm under this argument is shown in Figure 6.

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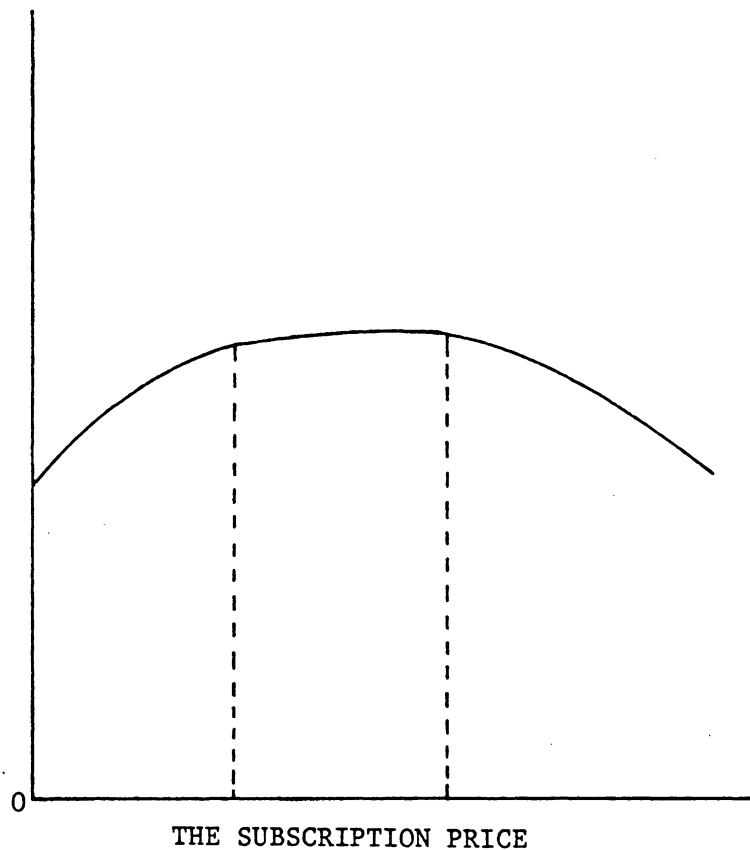
Figure 6:   The Range of Optimal Issue Price

Chapter III

MODEL ANALYSIS

In this Chapter, a new model of the optimal allocation ratio is presented. The primary distinguishing feature of this model is the explicit recognition that there are several real costs associated with the distribution of the new offering. A theoretical two-period, multiple-state model is constructed. At the initial period, the firm contracts with the syndicate, paying the initial standby fee, and at the end of the period the owners' subscription rate is revealed and the issuer and syndicate then distribute the remaining shares. Hence, in the second period the remaining flotation costs are incurred. It is assumed that the management of the firm is risk averse and acts to maximize its expected utility of wealth. In the process of maximizing the firm's expected utility, a model for the determination of optimal allocation ratio is derived.

3.1 RISK AVERSION AND PERFECT COMPETITION

We start by specifying the attitude of the firm towards
risk and the competitiveness of the underwriting industry.
As Mandelker and Raviv [27, p. 686] state: "the fact that
firms seek insurance contracts from underwriters and are
willing to pay a premium in order to avoid being exposed to
flotation risk is inconsistent with risk neutrality and im-
plies a risk averse behavior." Given this recognition of
issuer risk averse behavior, throughout most of this study
the issuing firm is assumed to be risk averse and acts to
maximize the expected utility of wealth.[1] Letting U(.) de-
note the firm's utility function, the utility function is
assumed to be twice differentiable and concave, hence

$$U' > 0, \qquad U'' < 0 \qquad\qquad (16)$$

where partial derivatives are indicated by primes ;i.e.,
$U'(.) = \partial U / \partial(.)$.

The investment banking industry is assumed to be perfect-
ly competitive. This assumption is supported by the recent
findings of Hayes and is acknowledged by others. According
to Hayes, for example, competition in the underwriting in-
dustry emerged at the start of the deregulation of brokerage
rates, and has further intensified in the presence of out-

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[1] However, risk aversion is not a necessary assumption and
it will be relaxed in later discussion.

side forces, such as competition from commercial banks, the
do-it-yourself trend of corporation finance and internation-
al inroads. Quoting from Hayes' study [21, p. 153]:

> The competition that was a ripple in the early
> part of the 1970s has become a billow in the lat-
> ter part, as the advent of negotiated rates in
> brokerage, the incursions of inflation, and the
> decline of the stock market have pitched Wall
> Street into a struggle for shares of the under-
> writing, securities distribution, corporate ser-
> vices, and institutional brokerage pies.

3.2   COST FACTORS

The most significant distinction of the model presented
here is the explicit recognition that all parties to the
flotation of securities through a standby rights offer will
incur some costs. Most previous analyses of the underwrit-
ing decision (e.g., Mandelker and Raviv [27], Barron [4],
Barron and Holmstrom [5]), ignore these costs. However, in
addition to the often recognized underwriter's fees, the is-
suing firm always incurs flotation expenses and distribution
expenses. Moreover, the underwriters incur expenses beyond
the familiar underwriting costs. The syndicate incurs syn-
dicate formation and operating expenses as well as signifi-

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[2] A typical breakdown of the underwriter's compensation, as
described by Hayes, is given on page 4.

cant expenses in distributing unsubscribed shares.[2] Finally,
owners have flotation costs too, these are viewed primarily
as portfolio adjustment and liquidity costs. These costs
are each discussed in turn in the following sections.

3.2.1   Flotation Cost of the Firm

   In this study, the term flotation cost refers to the ex-
penses the firm must bear in issuing shares to its owners.
In marketing an issue, certain fees can not be avoided;
e.g., the SEC registration fees, the legal and accounting
fees, the exchange listing fees, subscription agent fees,
transfer agent fees, state taxes, and mailing and printing
expenses. A portion of these flotation costs can be consid-
ered fixed, such as the registration fees and the legal and
accounting fees, while other cost components increase as the
volume of subscribed equity increases, such as subscription
agent fees, transfer agent fees and the costs of utilizing
the time of management. For a given level of gross funds to
be raised, I, the time and cost of administering the issue
and the cost of transferring titles to the stocks are as-
sumed to increase at an increasing rate as total subscrip-
tion increases. Let I_0 be the dollar amount of the issue
subscribed to by owners, denote the issuer's fixed flotation

costs by FC_F and variable costs by V_F, then the firm's total flotation cost, $F(I_0)$, is

$$F(I_0) = FC_F + V_F(I_0)$$

with

$$F'(I_0) > 0, \quad F''(I_0) > 0 \qquad\qquad (18)$$

That is, the issuer's flotation cost function is assumed to be strictly increasing and convex in I_0. This assumption represents the existence of the diminishing efficiency of management in the merchandising of new equity to current stockholders.

3.2.2   Distribution Cost of the Firm in Selling Unsubscribed Shares

Although the trend of do-it-yourself corporate financing has been increasingly popular in recent years [18], especially in such matters as private placement and merger negotiations, most firms continue to lack the in-house financing staff for mass distribution. This does not mean, however, that they can not economically distribute some fraction of the offering by themselves. In this Section this possibility is explicitly recognized.

In a standby contract, the underwriter is contractually bound to purchase all unsubscribed shares. As was mentioned in Section 2.2, underwriters typically receive a flat fee, partly for assuming the risk and partly for the syndicate's fixed expenses, plus a contingent per share take-up fee for every share that the syndicate has to purchase. Therefore, if the firm is able to distribute some of the unsubscribed issue through its subscription agent (say, by tapping some local institutions that the firm has a close relationship with) at a lower cost than the syndicate, a portion of the underwriter's fee can be saved. However, since the issuer's distribution capacity is often limited, it may outperform the syndicate only when this volume of direct equity sales is relatively small. As this volume of direct external sales increases, diminishing returns starts to buffet the capability of the issuer's limited sales staff. Let I_i denote the amount of equity sold by the firm to outside investors, and define $C(I_i)$ to be the firm's cost function to distribute unsubscribed shares, where[3]

$$C' > 0, \quad C'' > 0 \tag{19}$$

_____

[3] This assumption of $C' > 0$ is for ease of discussion and it is not entirely necessary for the ensuing analysis.

That is, the distribution cost function of the firm is assumed to be strictly increasing and convex representing increasing marginal cost of external equity sales.

3.2.3 Risk Premium and Other Fixed Syndicate Expenses

There are certain expenses which are paid to the investment bankers regardless of the actual level of subscription. For example, there is a payment for advice associated with the issue and there are also expenses incurred in the formation and maintenance of the syndicate. These fixed expenses are covered by the initial standby fee to the underwriting syndicate. In addition to these fixed expenses, the underwriters may incur ex-post losses if the market price of the issuer's stock falls below the negotiated subscription price. A portion of the fixed payment to underwriters is, therefore, attributable to the competitively set underwriting risk premium for guaranteeing the level of gross proceeds of the issue. Thus the standby fee, SB, can be broken down into two basic parts: the risk premium, RP, and other fixed syndicate expenses, FC_S.

$$SB = RP + FC_S \tag{20}$$

For a given issue size, the syndicate expenses are fixed regardless of the terms of the issue. The level of the risk premium, on the other hand, is not independent of the terms of the offering in general. To examine this dependence of the level of the risk premium upon the issue terms, in particular its depenence upon the allocation ratio, the Black and Scholes option pricing model may be used to provide the competitively determined underwriting risk premium. It has been recognized by Marsh [30] that the standby underwriting contract is a put option giving the firm the right to put a failed issue to the underwriter at the agreed upon subscription price. Given the current stock price(P_0), the term of the subscription period(T), the subscription price(P_S), the risk free interest rate(r), the variance rate of the return on the stock(σ^2), and invoking the Black and Scholes' option pricing model [7], the value of the risk premium per share(RP_S) can be written as:

$$RP_S = P_S e^{-rT} N(-d_1) - P_0 N(-d_2)$$

where $d_1 = [\log(P_0/P_S) + (r+\sigma^2/2)T] / \sigma \sqrt{T}$,

and $d_2 = [\log(P_0/P_S) + (r-\sigma^2/2)T] / \sigma \sqrt{T}$.

The value of the total risk premium is the per share risk premium times the total number of new shares:

$$RP = n_1 P_S e^{-rT} N(-d_1) - n_1 P_0 N(-d_2)$$

or

$$RP = I e^{-rT} N(-d_1) - (n_0 P_0 / N) N(-d_2) \qquad (21)$$

It can be proved that[4]

$$\partial RP / \partial N > 0 \qquad (22)$$

That is, ceteris paribus, the underwriting risk premium is increasing in the allocation ratio. Hence the risk premium is increasing in the issue price. The obvious explanation for this behavior of the risk premium is that as the allocation ratio is increased, the likelihood of reduced subscription, hence underwriter losses, is enhanced.

3.2.4   Distribution Cost of the Underwriter

Given the size of the issue, the investment banker's distribution cost will increse as the number of shares unsubscribed increases. Furthermore, as the volume to be distributed increases, it becomes increasingly difficult for the underwriter to locate interested investors and hence the cost of inventory rises. Increasing distribution cost may explain the ascending take-up fee arrangement observed in the prospectus of most underwriting rights offerings, where

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[4] The proof is offered in Appendix A.

typically the take-up fee increases in a step-wise manner as the rate of subscription decreases. Given I, I_0 and I_i , the distribution cost function of the syndicate is denoted by $S(I-I_0-I_i)$ with

$$S' > 0, \quad S'' > 0 \tag{23}$$

That is, the distribution cost of the syndicate is assumed to be strictly increasing and convex.

3.2.5   Owner's Cost

The final set of participants involved in the rights offering is the owners. In subscribing to shares, owners incur liquidity cost, portfolio adjustment cost as well as transactions cost. For example, in some prospectus' one can find a record of a 2¢ or so fee per right handled by the subscription agent. When this fee is multiplied by the allocation ratio, the cost to the owner of obtaining one new share in this way can become substantial, an amount sometimes equal to the firm's quarterly dividend payment. Furthermore, due to differences in owner's liquidity preference, it will be increasingly costly for each additional subscription, as the issuer seeks to attract the capital of those marginal owners having greater liquidity need. Define

$Q(I_0)$ to be the subscription cost for the firm's stockholders, with

$$Q' > 0, \quad Q'' > 0 \qquad\qquad\qquad (24)$$

In other words, the owner's subscription cost function is assumed to be stricty increasing and convex representing increasing marginal cost of subscription.[5] The behavior of this function therefore reflects the ordering of subscribers, by their respective individual subscription costs, from least costly to most costly subscription.

3.3   THE DETERMINATION OF EQUILIBRIUM SUBSCRIPTION

At this point it is instructive to demonstrate the determination of equilibrium subscription, I_0. From the previous discussion (equation (13)), it was shown that owners will not cash in their rights until the end of the subscription period. Hence, the equilibrium subscription level is not revealed until the second period. Economic theory tells us that owners will not purchase new shares unless their marginal gain is higher than their marginal cost. To subscribe

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[5] In addition, it is assumed that $Q'(I_0=0) = 0$ for ease of discussion. However, this is not necessary. $Q'(I_0=0)$ could be greater than zero, or, less than zero.

to one share, an owner has to give up P_S dollars in exchange for the gain of N rights, hence the gain per dollar from subscription is the per dollar value of the rights otherwise forfeited by not subscribing,

$$G = NR/P_S = (n_0/I)R. \tag{25}$$

Since both n_0 and I are constant, it is apparent that

$$\partial G/\partial R > 0,$$

that is, the gain per dollar from subscription is directly influenced by the value of one right.

Now we want to show the behavior of this gain as the amount of subscription increases. In addition, a new factor is introduced into the valuation of rights. Denote the rate of subscription by $v = I_0/I$, $0 \leq v \leq 1$, the following two equations must hold by arbitrage:

$$P_0 n_0 + v n_1 P_S = P_1 (n_0 + v n_1) \tag{26}$$

$$NR + P_S = P_1 \tag{27}$$

Equation (26) states that the value of the owner's existing equity plus their newly subscribed equity equals the post subscription value of their equity. Equation (27) states the condition that the value of N rights plus the subscription price equals the ex-rights stock price.

From (26), $P_1 = (P_0 n_0 + vn_1 P_S)/(n_0 + vn_1)$,

or $\quad\quad\quad P_1 = (NP_0 + vP_S)/(N + v)$. $\quad\quad\quad$ (28)

Substituting P_1 into (27) yields the value of one right

$\quad R = (P_0 - P_S)/(N + v)$

$\quad\quad = (P_0 - P_S)/[N + (I_0/I)]$. $\quad\quad\quad$ (29)

Substituting (29) back into (27) we obtain

$\quad P_0 = P_1 + vR$ $\quad\quad\quad\quad\quad\quad$ (30)

Equation (29) and equation (30) give the theoretical value of one right. This value differs from the value obtained in the literature (see Section 2.3.1.2) where it is presumed that v always equals one. Thus, the gain per dollar to sub-scribing shares can be reexpressed as

$\quad G(I_0) = n_0 R/I = n_0(P_0 - P_S)/I[N+(I_0/I)]$ $\quad\quad$ (31)

The first and the second derivatives of G with respect to I_0 are:

$\quad G'(I_0) = \partial G/\partial I_0 = -n_0(P_0 - P_S)/(IN + I_0)^2$

$\quad\quad\quad = -G/(IN + I_0) < 0$

and

$\quad G''(I_0) = \partial^2 G/\partial I_0^2 = 2n_0(P_0 - P_S)/(IN + I_0)^3$

$$= 2G/(IN+I_0)^2 \ > 0. \qquad\qquad (32)$$

That is, the gain per dollar subscribed decreases at an decreasing rate as the amount subscribed increases.

From equation (27) it is clear that, ceterus paribus, the value of a right is positively influenced by the ex-rights price per share and negatively related to the allocation ratio. Since the market price of a share reflects the present value of the firm's future earnings, the value of one right is therefore a function of the allocation ratio and the firm's future earnings. Denote the present value of the firm's future earnings by X, then

$$R = R(N,X). \qquad\qquad (33)$$

Moreover, as demonstrated in equation (25), the gain per dollar from subscription depends upon the value of the right, hence it is also a function of the allocation ratio and the level of future earnings:

$$G = G[R(N,X)] = G(N,X). \qquad\qquad (34)$$

As noted earlier, the gain per dollar from subscription is directly influenced by the value of one right, consequently, it increases as the level of future earnings increases and decreases as the allocation ratio increases. Figure 7 shows

GAIN PER DOLLAR
SUBSCRIBED

$G[R(N_1,X)]$

$G[R(N_2,X)]$

$G[R(N_3,X)]$

0

I

AMOUNT SUBSCRIBED
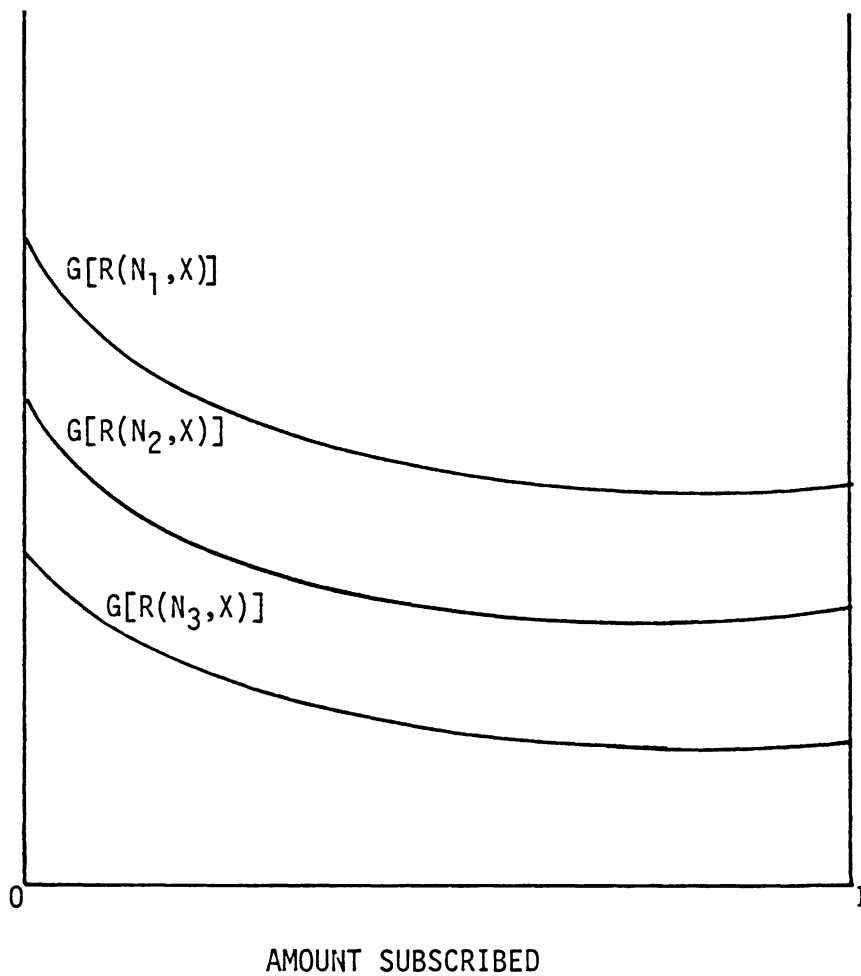
Figure 7: The Gain per Dollar from Subscription

the ex post function of marginal gain from subscription for various allocation ratios, where $N_1 < N_2 < N_3$.

As long as the gain per additional dollar from subscription is greater than the cost per dollar of subscription, that is, $G > Q'$, subscription will continue to occur. In equilibrium, the per dollar gain will therefore equal the per dollar subscription cost to the marginal subscriber,

$$G(N,X) = Q'(I_0).$$ (35)

It should be emphasized that the allocation ratio, N, is selected at the beginning of the period while equation (35) is an ex post market clearing condition. From this ex post market clearing condition, the implicit function of I_0 is therefore determined:

$$I_0 = I_0(N,X)$$ (36)

where (36) indicates the ex post market clearing subscription level as a function of the ex ante allocation ratio decision and the level of ex post earnings.

Before entering into the model, it is useful to clarify a property of $I_0(N,X)$, that is, the relationship between the allocation ratio and the amount subscribed. From (35) and (25), the marginal cost of subscription can be written as

$$Q'(I_0) = n_0(P_0-P_S)/I[N+(I_0/I)] \qquad (37)$$

$$= (n_0 P_0 - IN)/(IN+I_0)$$

Differentiating Q' with respect to I_0 we obtain

$$Q''dI_0 = -[(IN+I_0)IdN + (P_0 n_0 - IN)(IdN+dI_0)]/(IN+I_0)^2$$

or

$$[Q''(IN+I_0)^2 + (P_0 n_0 - IN)]dI_0 = -(P_0 n_0 + I_0)IdN .$$

Divide both sides by $(IN+I_0)^2$,

$$[Q'' + Q'/(IN+I_0)]dI_0 = \{-[(P_0 n_0 - IN)+(IN+I_0)]/(IN+I)^2\}IdN$$

then solving for the marginal effect of the allocation ratio on the subscription level of current stockholders

$$dI_0/dN = -\{[Q'/(IN+I_0)]+[1/(IN+I_0)]\}I \; / \; [Q''+Q'/(IN+I_0)]$$

hence

$$dI_0/dN = -[1+Q']I \; / \; [Q''(IN+I_0)+Q'] . \qquad (38)$$

Since both Q' and Q'' are positive, the first derivative of I_0 with respect to N is demonstrated to be unambiguously negative. That is, ceteris paribus, the ex post amount subscribed to by owners will decrease as the ex ante allocation ratio increases:[6]

$$dI_0/dN < 0 \qquad (39)$$

_____

[6] Note that $dI_0/dN = 0$ if $I_0 = I$.

Equation (39) is a crucial result as it is a property of the ex post equilibrium condition for owner's subscription. The rationale for this condition is rather simple: as the allocation ratio increases the issue price also increases, this lowers the value of rights, consequently, the gain per dollar from subscription decreases and fewer owners find it worthwhile to subscribe. Figure 8 illustrates the determination of the equilibrium subscription level as well as the effect of changes in the allocation ratio on the equilibrium amount of equity subscribed.

MARGINAL GAIN AND
MARGINAL OWNER'S
COST
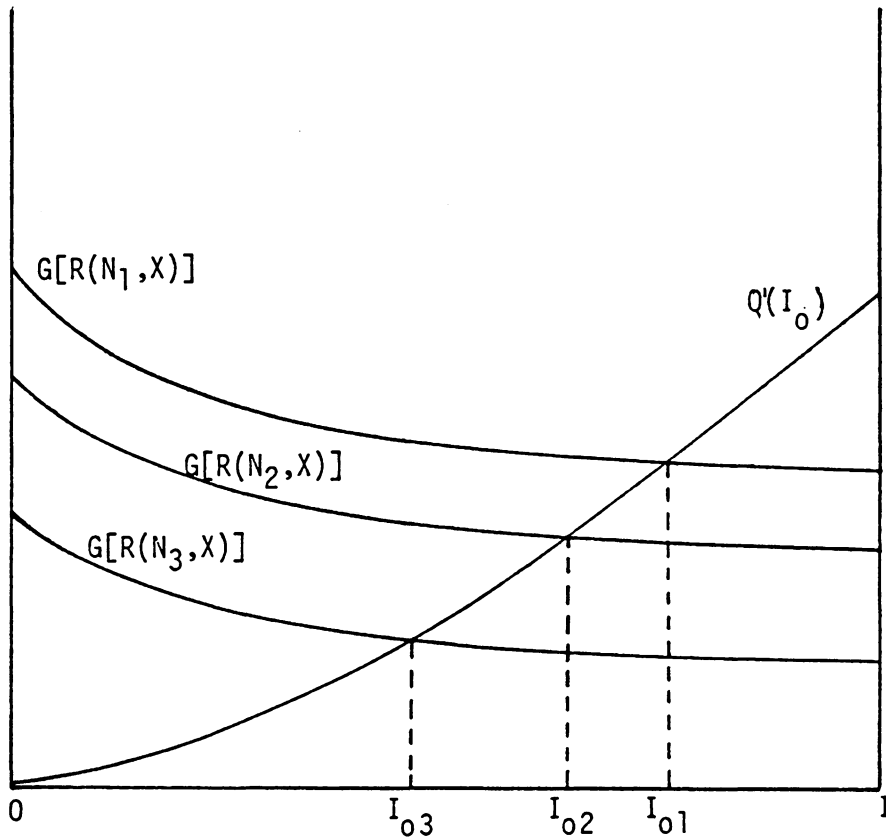
where $N_1 < N_2 < N_3$

Figure 8: The Determination of Equilibrium Subscription

3.4   THE DETERMINATION OF EQUILIBRIUM DISTRIBUTION

In this section we will derive the second ex post market clearing condition of the model, that is, the determination of the ex post equilibrium distribution of unsubscribed shares between the issuer and the underwriters. Given that owners have subscribed to I_0, as is set out by equation (35), the firm and the underwriter must distribute the remaining unsubscribed shares. The equilibrium distribution of these unsubscribed shares is determined by minimizing total distribution costs; that is, the firm and the underwriter will each distribute to the point such that total cost of distribution is minimized. Denote the total cost of distribution by TD, then TD is the sum of the issuer's and the underwriter's costs of distributing unsubscribed shares;

$$TD = C(I_i) + S(I-I_0-I_i).$$

Minimizing TD yields the following condition

$$C'(I_i) = S'(I-I_0-I_i). \qquad (40)$$

Equation (40) is the second equilibrium ex post market clearing condition, and it states that the distribution of unsubscribed shares is allocated so that marginal cost to the issuer just equals the marginal cost to the underwriters, given that owners have subscribed to I_0. From (40) the following implicit function I_i can be derived:

$$I_i = I_i[I_0(N,X)],$$

or   (41)

$$I_i = I_0(N,X)$$

Total differentiating (40) yields

$$C''dI = S''(-dI_0 - dI_i),$$

hence

$$dI_i/dI_0 = - S''/(S''+C'') < 0 \qquad (42)$$

hence

$$dI_i/dN > 0 \qquad (43)$$

Having derived the two ex post market clearing conditions, (35) and (40), we will now specify the model of allocation ratio determination.

3.5 THE MODEL OF ALLOCATION RATIO DETERMINATION

Assume that at time t=0, the owners have endowed wealth, W; the firm decides to undertake the investment project; the firm arranges a standby underwriting contract with the syndicate; the firm determines the allocation ratio and pays the initial standby fee to retain the syndicate. Instantaneously the stock goes ex-rights. At time t=1, the rights expire as owners subscribe, other costs associated with flotation, distribution and subscription are incurred and the firm receives gross proceeds of I dollars.

The possible event states revealed at t=1 are defined by: (a) the present value of future earnings on all investments of the firm, and (b) the comparative efficiency of the firm's distribution cost, C, vis-a-vis the underwriter's distribution cost, S. The present value of future earnings, X, is a random variable whose distribution at t=1 is assumed to range from X_{min} to X_{max}. The probility density function of X is denoted by f(X). Since the market value of stock reflects the firm's future earnings, the market price of stock is an increasing function of X. The value of a right and, therefore, the level of I_0 are also increasing in X. A detailed breakdown of the events is analyzed as follows.

3.5.1   The Ex Ante Event Space

The possible states of future earnings are divided into four subsets, each corresponds to different and increasing level of earnings.   The first set of states, $[X_0, X_1)$, is defined as those states in which future earnings are so low that the market price of the firm's stock is below the negotiated subscription price. Over these states the value of each right is zero and no owners subscribe.   Consequently, over this set of states only the firm and the syndicate distribute all the shares; and that amount is determined ex post according to the relative marginal costs ; i.e., by the point where $C' = S'$ (See Figure 9 for a graphic presentation). X_1 is defined to be the level of earnings at which the market price is just equal to the subscription price,[7] hence the value of a right just equals zero.

The second event interval, $[X_1, X_2)$, is defined as the set of states where future earnings are large enough so that the market price of stock will exceed the subscription price (that is, $R > 0$) and some owners find it worthwhile to subscribe.   Once the amount subscribed is revealed ex post, the firm and the syndicate will distribute the unsubscribed shares according to their relative marginal distribution

---

[7] At X_1, $X_1 -$ costs $= P_1 (n_0 + n_1) = P_S (n_0 + n_1)$

hence, $X_1 = P_S n_0 + P_S n_1 + C(I_i) + F(I_0 = 0) + S(I - I_i)$

MARGINAL COST

C'(v=0)

S'

0 I_i $I - I_i$ I
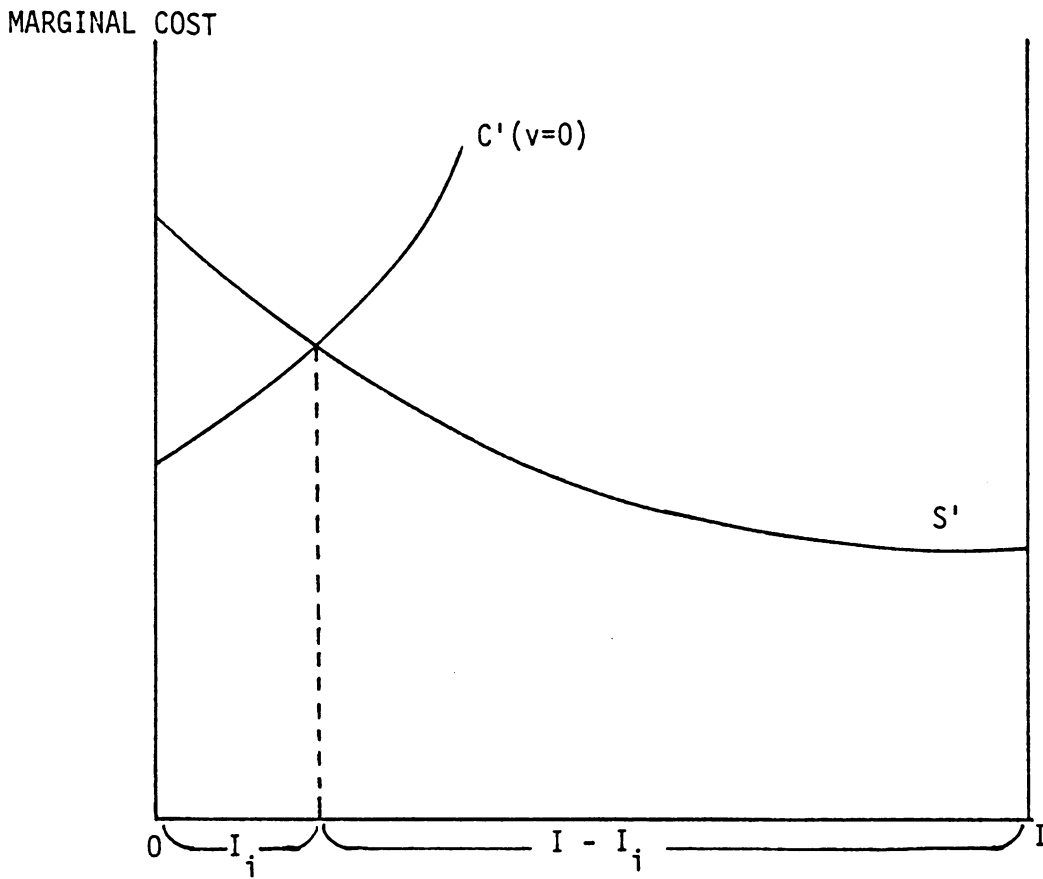
R = 0, owners subscribe none,
    firm distributes I_i ,
    syndicate distributes $I - I_i$

Figure 9:   Event Set 1

costs. One example of this expost equilibrium is given in Figure 10.

Exhibited in the Figure are the marginal distribution costs of the firm and the underwriter, as well as the marginal gain from subscription for some level of earnings within the range of $[X_1, X_2)$. In this example owners subscribe up to I_0, where $Q' = G$. The firm's marginal distribution cost function is lower than the syndicate's marginal distribution cost for the next I_i amount of equity, hence the firm distributes I_i and the syndicate takes up the remaining issue $(I-I_0-I_i)$. Note that $C'(v=v_1)$ indicates the location of C' when $v = v_1$.

At X_2, the level of earnings is defined to be such that the marginal cost to the firm to distribute the initial unit, $C'(0)$, is just equal to the marginal cost to the underwriter to distribute all the unsubscribed shares, $S'[I-I_0 (X_2)]$. Hence, at this level of earnings, the underwriter distributes all unsubscribed shares.

The third state interval, $[X_2, X_3)$, is specified by the states where the market price is higher than the price of the second interval, hence an even larger number of owners will subscribe to the offer. Over these states the marginal cost of the underwriter is lower than the distribution cost of the issuer. It is more efficient, therefore, for the underwriter to distribute the remaining unsubscribed shares.

MARGINAL COST AND
MARGINAL GAIN
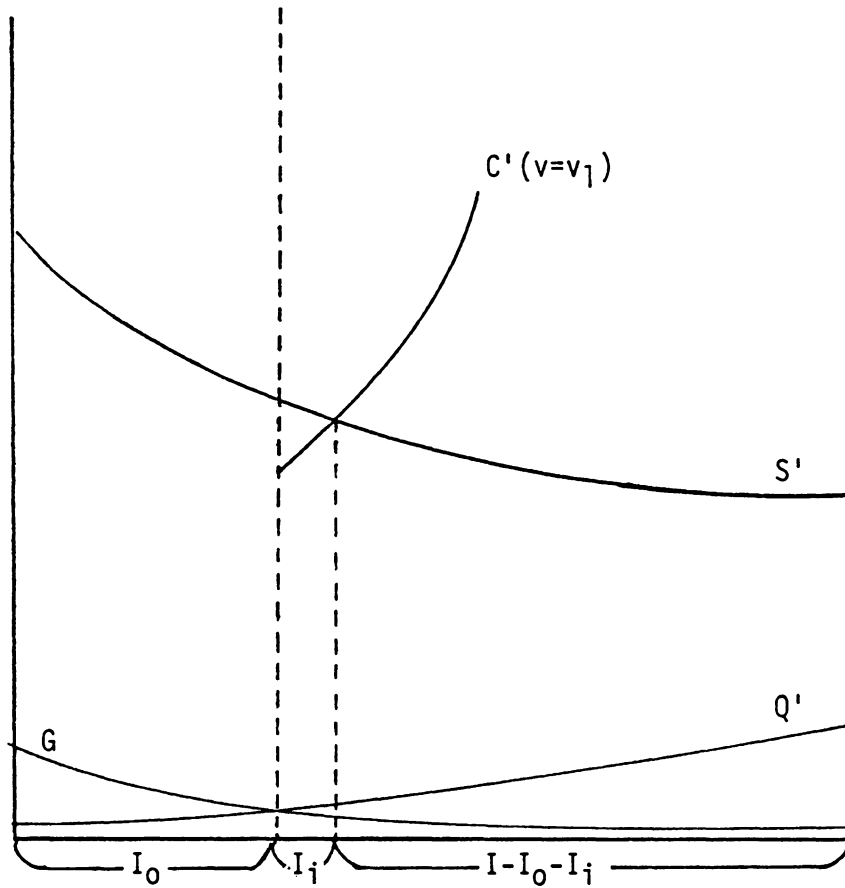
R > 0, owners subscribe to I_0
firm distributes I_i
syndicate distributes $I-I_0-I_i$

Figure 10:   Event Set 2

This case is presented in Figure 11. Here, as G goes up, the amount of equity subscribed is higher than that exhibited in Figure 10. The syndicate will distribute the remaining shares($I-I_0$) since its marginal cost of distribution is lower than the firm's marginal cost for that level of subscription. Also shown in Figure 11 is the relative position of X_2. X_3 is defined as the point where the marginal subscription cost for the last owner, $Q'[I_0(X_3)=I]$, just equals the marginal gain from subscription, G. Hence, at earnings equal to X_3, the issue is fully subscribed by owners.[*]

The last set of states, $[X_3, X_4]$, is defined as those states where future earnings are most promising, hence the market price is so favorable, that all owners find it worthwhile to subscribe. At X_4, earnings, hence the market price of stock, reaches its maximum (see Figure 12.) The division of event sets is graphically presented in Figure 13. Table 2 summarizes the event outcomes.

---

[*] The phenomenon that I_i decreases as X increases can be proved as follows:
$$\partial I_i/\partial X = (\partial I_i/\partial I_0)(\partial I_0/\partial X) = (\partial I_i/\partial I_0)(\partial I_0/\partial R)(\partial R/\partial X).$$
It has been demonstrated by equation (42) that $\partial I_i/\partial I_0 < 0$; furthermore, from the discussions of equations (39) and (33), it is clear that that $\partial I_0/\partial R > 0$ and $\partial R/\partial X > 0$, thus $\partial I_i/\partial X < 0$.

MARGINAL COST AND
MARGINAL GAIN
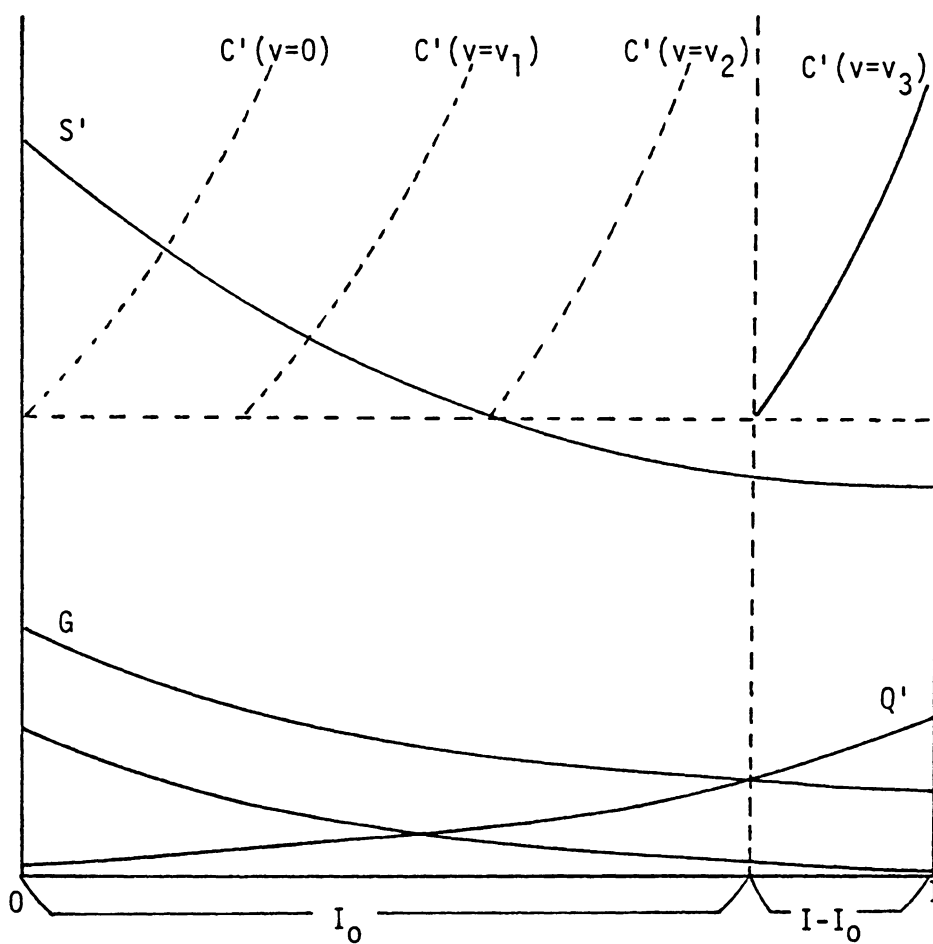
owners subscribe to I_0

syndicate distributes $I-I_0$

Figure 11:   Event Set 3

MARGINAL COST AND
MARGINAL GAIN

S'

G

Q'

0

I_0

I
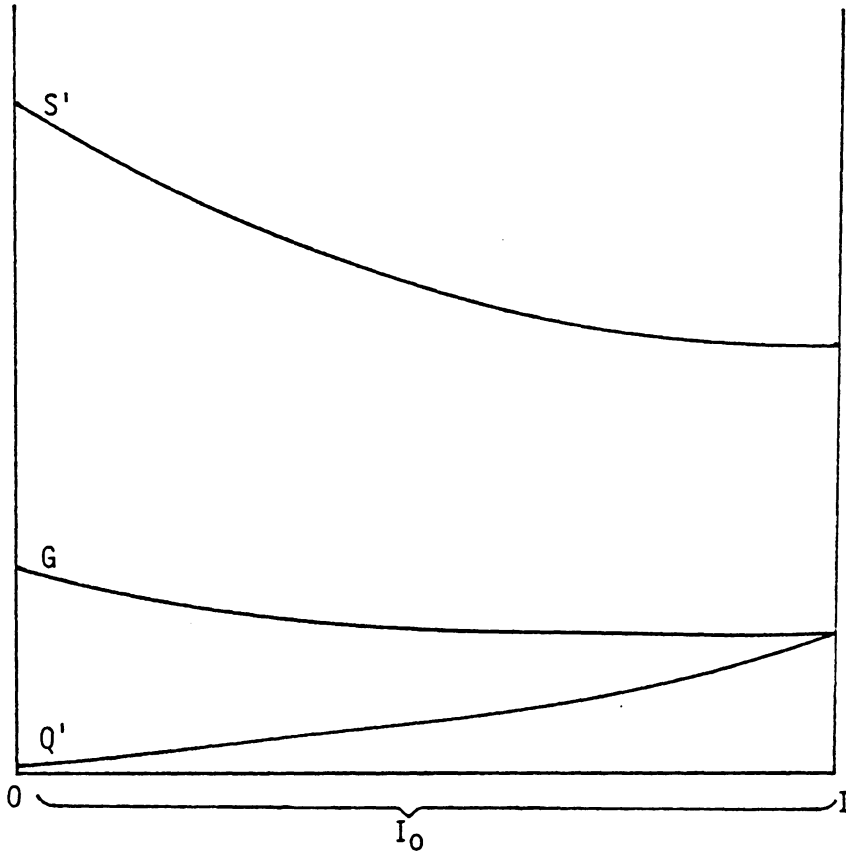
v = 1, owners take all

Figure 12:   Event Set 4

MARGINAL
COST

$[X_0,X_1)-($ •————————$[X_1,X_2)$————————(•————————$[X_2,X_3)$————————(•$[X_3,X_4]$
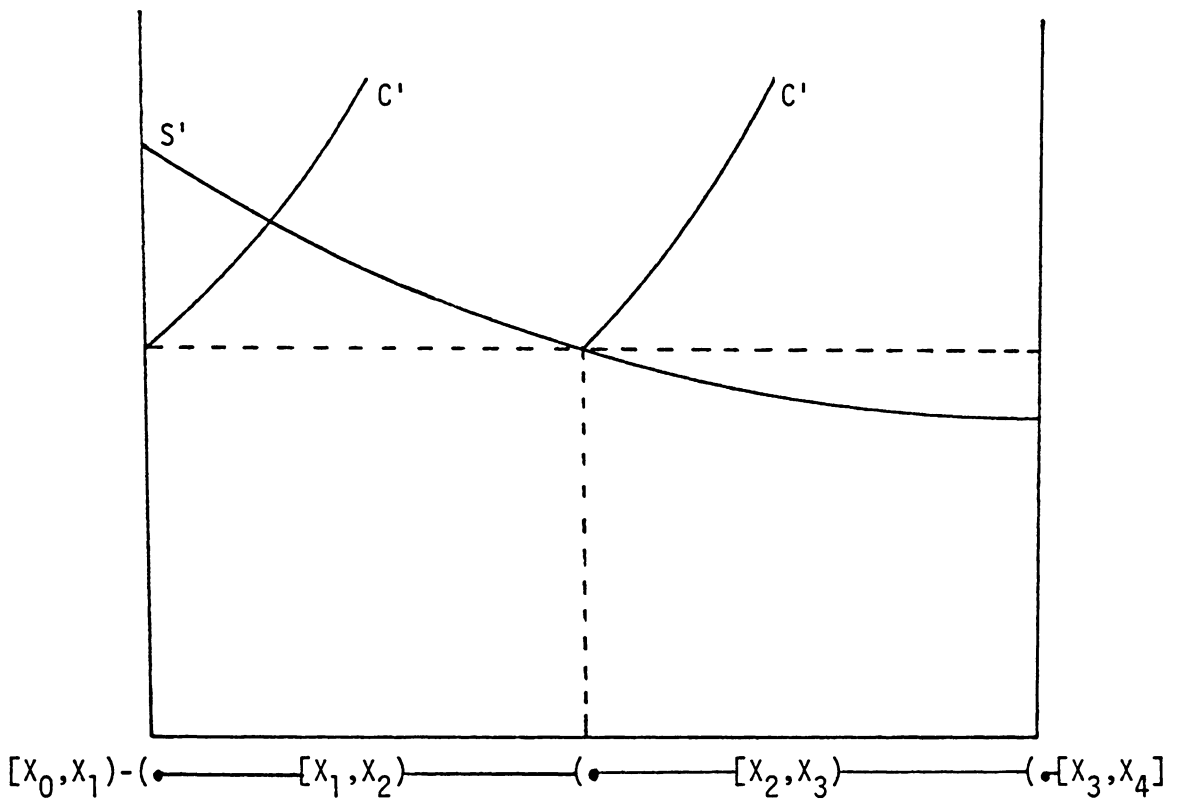
Figure 13: The Event Space of Subscription and Distribution

TABLE 2

Summary of Event Outcomes

state outcomes				state interval
market price	value of right	subscription rate	distribution of issue	
$P_1 < P_S$	$R = 0$	$v = 0$	firm and syndicate	$[X_0, X_1)$
$P_1 > P_S$	$R > 0$	$0 < v < 1$	owners, firm and syndicate	$[X_1, X_2)$
$P_1 > P_S$	$R > 0$	$0 < v < 1$	owners & syndicate	$[X_2, X_3)$
$P_1 > P_S$	$R > 0$	$v = 1$	owners	$[X_3, X_4]$

Note:

at X_0, $X = X_{min}$, $P_1(X_0) = P_{1min}$

at X_1, $P_1(X_1) = P_S$

at X_2, $C'(0) = S'[I-I_0(X_2)]$ (44)

at X_3, $Q'[I_0(X_3)=I] = G(N,X_3)$

at X_4, $X = X_{max}$, $P_1(X_4) = P_{1max}$

3.5.2 The Objective Function

In Section 3.1, we assume risk aversion for the firm and perfect competition in the underwriting industry. Given that the investment decision is fixed, the objective of firm in making the financing decision is to maximize the expected utility, E[U], of wealth:

$$\underset{N}{\text{Max}} \ E[U] = U_0(W_0) + \int_{X_0}^{X_4} U_1(W_1) f(X) dX \qquad (45)$$

where W_0 is beginning period (t=0) wealth and W_1 is end of period (t=1) wealth. U_0 and U_1 are the utility functions of t=0 and t=1, respectively. The beginning period wealth[9] is defined to be the wealth endowed at t=0, minus the initial standby payment to the underwriting syndicate, and the end of period wealth is defined to be the present value of all future earnings at t=1 minus the flotation cost, the distribution costs of the firm and the underwriter, and the owner's cost in connection with the financing.

$$W_0 = W - SB = W - RP - FC_S$$
$$W_1 = X - F(I_0) - C(I_i) - S(I - I_0 - I_i) - Q(I_0) \qquad (46)$$

---

[9] The beginning wealth is the wealth endowed plus the current value of shares, minus the standby fee and minus the investment in shares.
   $W_0 = (W + P_0 n_0) - (SB + P_0 n_0) = W - SB$
where P_0 is the current price of stock without the effect of standby fee.

In Section 3.2.3 we have shown that the risk premium is an increasing function of N. By inequality (39), we also know that the amount subscribed, I_0, is decreasing in N. In addition, I_0 is increasing in X. This follows since P_1 is increasing in X and I_0 is increasing in P_1, so I_0 is increasing in X. Thus, combined with the earlier definitions of states of earnings, the objective function can be rewritten as:

$$\text{Max EU} = U_0[W - RP(N) - FC_S]$$

$$+ \int_{X_0}^{X_1} U_1 \{X - F[I_0(N,X) = 0] - C[I_i(N,X)] - S[I - I_i(N,X)]\} f(X) d(X)$$

$$+ \int_{X_1}^{X_2} U_1 \{X - Q[I_0(N,X)] - F[I_0(N,X)] - C[I_i(N,X)] - S[I - I_0(N,X) - I_i(N,X)]\} f(X) dX$$

$$+ \int_{X_2}^{X_3} U_1 \{X - Q[I_0(N,X)] - F[I_0(N,X)] - S(I - I_0(N,X)]\} f(X) dX$$

$$+ \int_{X_3}^{X_4} U_1 \{X - Q[I_0(N,X) = I] - F[I_0(N,X) = I]\} f(X) dX \qquad (47)$$

In equilibrium, the maximization of equation (47) is subject to the two ex post market clearing conditions discussed earlier: (1) the equality of owner's marginal cost of subscription with the marginal gain of subscription, and (2) the

equality of firm's marginal distribution cost with syndi-
cate's marginal distribution cost. These are incorporated
in the model by the use of

$$I_0 = I_0(N,X),$$

$$I_i = I_i(N,X).$$

The first-order condition for the above problem is

$$\partial E[U]/\partial N = U_0'(-\partial RP/\partial N)$$
$$+ \int_{X_1}^{X_3} U_1'[(S'-F'-Q')(\partial I_0/\partial N)]f(X)dX \qquad (48)$$

Now if we use the expectation operator

$$E_{ij}[.] = \int_{X_i}^{X_j} [.]f(X)dX,$$

the first order condition can be written as

$$\partial E[U]/\partial N = U_0'(\partial RP/\partial N) + E_{13}[U_1'(S'-F'-Q')(\partial I_0/\partial N)]. \qquad (49)$$

Consequently, the optimum allocation ratio for a standby
rights offering satisfies[10]

$$\partial EU/\partial N = U_0'(-\partial RP/\partial N) + E_{13}[U'(S'-F'-Q')(\partial I_0/\partial N)] \qquad (50)$$

---

[10] Since $U_0'(-\partial RP/\partial N) < 0$, a corner solution exists only if
$E_{13}\{U_1'[(S'-F'-Q')(\partial I/\partial N)]\} < 0$
In that case, $\partial EU/\partial N < 0$ and the firm should make the al-
location ratio as low as possible to maximize its expect-
ed utility. However, this is a rather uninteresting case
and we will concentrate on the issue of interior optimal-
ity. Note also that the end point conditions from Leib-
nitz rule also vanish.

$$= 0$$

or

$$U_0'(\partial RP/\partial N) = E_{13}[U_1'[(S'-F'-Q')(\partial I_0/\partial N)]] \tag{51}$$

Equation (51) explains the reason why firms can not just arbitrarily lower the subscription price, as the irrelevance school suggests, to insure a successful subscription. To achieve optimality, an equilibrium condition of the marginal utilities hence an equilibrium relationship of the marginal costs, is required of the allocation ratio.[11] By setting a low allocation ratio although the marginal syndicate's fee (including risk premium as well as distribution expense) may be reduced, the costs saved is, however, offset by the increase in marginal flotation cost and marginal subscription cost. Figure 14 illustrates the underwriter's as well as the firm's marginal cost functions.

Furthermore, equation (50) is equal to

$$-U_0'(\partial RP/\partial N) + E_{13}[U_1']E_{13}[(S'-F'-Q')(\partial I_0/\partial N)]$$
$$+ COV[U_1',(S'-F'-Q')(\partial I_0/\partial N)] = 0 \tag{52}$$

hence

$$-E_{13}[S'(\partial I_0/\partial N)] + (\partial RP/\partial N)\{U_0'/E_{13}[U_1']\} \tag{53}$$

---

[11] Of course, if "total" syndicate cost is lower than "total" firm cost, the firm will choose a firm commitment contract and the determination of allocation ratio may be quite different in that case.

MARGINAL
COST

THE AMOUNT OF EQUITY SUBSCRIBED BY OWNERS
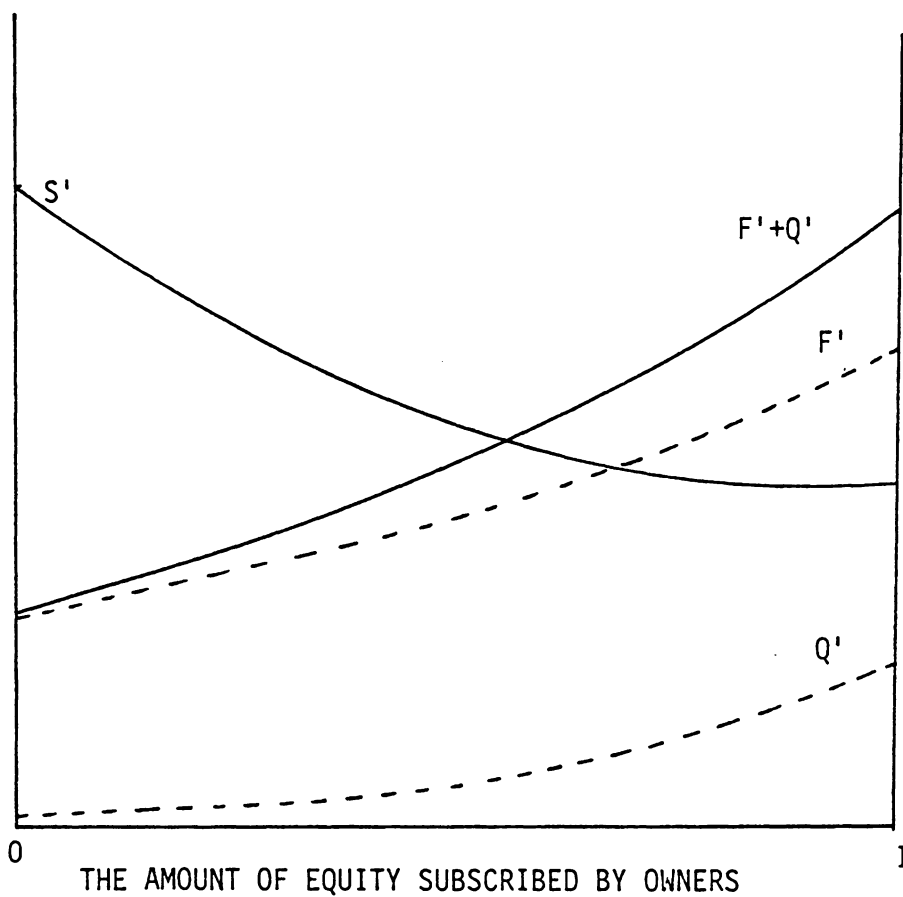
Figure 14:   Marginal Cost Functions for the Firm, the
            Underwriter and the Owner

$$= -E_{13}[(F'+Q')(\partial I_0/\partial N)] + COV[U_1', (S'-F'-Q')(\partial I_0/\partial N)]/E_{13}[U_1'].$$

Recall from equation (22) and (39) that $\partial RP/\partial N > 0$, $\partial I_0/\partial N < 0$, therefore all terms except the covariance in equation (53) are known to be positive. A closer examination of equation (53) reveals that the left hand side(LHS) of equation (53),

$$-E_{13}[S'(\partial I_0/\partial N)] + (\partial RP/\partial N)\{U_0'/E[U_1']\},$$

is the sum of the expected marginal syndicate distribution cost and the marginal syndicate risk premium adjusted by the issuer's rate of time preference. In other words, the LHS of (53) is the current marginal investment banking costs to the issuer. On the other hand, the right hand side(RHS) of equation (53),

$$-E_{13}[(F'+Q')(\partial I_0/\partial N)] + COV[U_1', (S'-F'-Q')(\partial I_0/\partial N)]/E_{13}[U_1'],$$

consists of a term representing the marginal internal flotation costs to shareholders and a covariance term. The latter represents an addition to marginal cost due to issuer risk aversion. Unfortunately, however, the sign of the covariance term is ambiguous, its direction depends on the distribution of future earnings as well as the elasticities of the marginal cost functions. (The signing problem of the covariance term is discussed in Appendix B.)

Finally, equation (53) also has implications for the risk neutral case. Since the marginal utility, U', is constant under risk neutrality, the covariance term vanishes and equation (53) becomes

$$-E_{13}[S'(\partial I_0/\partial N)] + (\partial RP/\partial N)\{U_0'/E_{13}[U_1']\}$$

$$= -E_{13}[(F'+Q')(\partial I_0/\partial N)]. \tag{54}$$

This establishes the result that when the assumption of issuer risk aversion is relaxed, it may still pay for the firm to contract with a syndicate to distribute and underwrite the issue, if, in equilibrium, the above condition holds. In this case, the risk premium is viewed to be competitively determined and commanded by the syndicate for holding the put option, and, evidently, it may be cheaper for a risk neutral issuer to pay this additional cost than to distribute the entire issue without help from the underwriter.

Thus far we have derived the optimality condition and analyzed the economic meaning behind it. In the process, the allocation ratio for standby rights offering is determined. The empirical implicatons of the model are discussed in next chapter.

Chapter IV

THE ALLOCATION RATIO DECISION: AN EMPIRICAL ANALYSIS

The purpose of this Chapter is to empirically examine the allocation ratio decision of U.S. firms and, in the process, to test the hypotheses derived from the theoretical model for allocation ratio determination of Chapter III, as well as the alternate allocation ratio theories of Beranek and Levy and Sarnat.

In Chapter II, various doctrines on the relevancy and irrelevancy of the allocation ratio decision are presented. Among those asserting the relevancy of the allocation ratio dicision are Levy and Sarnat's dividend policy cost hypothesis and Beranek's share transfer cost hypothesis. Levy and Sarnat [24] focus upon the effect of the allocation ratio on future per share dividend payments and they maintain that a low allocation ratio, hence a larger number of shares issued, will increase the firm's future dividend payments in order to maintain existing per share dividend policy. Therefore, according to Levy and Sarnat, the higher is the cost of dividend policy the larger shall be the optimal allocation ratio, ceterus paribus. Beranek [11] argues that, due to the cost in transferring share titles, there is a

lower limit of the allocation ratio beyond which total issue costs will begin to increase. According to Beranek's argument, therefore, a lower allocation ratio, hence a larger number of shares issued, is associated with a higher cost of transferring share titles. In Chapter III, a new model of the optimal allocation ratio decision is presented which explicitly takes into account the various cost components associated with the merchandising of the offering. Thus, any factor having influence on the specific cost components is expected to influence the determination of the allocation ratio.

To examine the determintion of the allocaiton ratio, we begin with some assumptions about the relationships between the cost components in a rights offering and the relevant exogenous variables. A regression model is presented and hypotheses about the impacts of various exogenous variables on the allocation ratio are derived by the comparative statics analysis. Finally, measures of the explanatory variables, including the measure for the importance of dividend policy, are constructed and regression coefficients estimated.

4.1 FACTORS INFLUENCING THE COST COMPONENTS OF A RIGHTS OFFERING

The issue cost components discussed in Section 3.2 are identified as ceterus paribus functions of the amount of equity subscribed by owners. To analyze the effects of changes in the exogenous variables on those cost functions, let

$$S = S(\underline{s}:vI)$$

$$F = F(\underline{f}:vI)$$

$$Q = Q(\underline{q}:vI)$$

$$RP = RP(\underline{r}:vI)$$

where $\underline{s}$, $\underline{f}$, $\underline{q}$, and $\underline{r}$ each denote a vector of exogenous variables having influence on the respective cost component, and each function is currently evaluated at the optimal level of owner subscription, vI.

For example, vector $\underline{s}$ may include the size of the issue and a measure of primary capital market conditions. Several studies have found evidence of cost economies of scale with respect to both dollar volume and the number of transactions [14], [31], [40], [43]. Therefore, it is expected that the underwriter's marginal cost of distribution will decrease as issue size increases, ceterus paribus. However, the effect of capital market supply on underwriter's distribution cost is ambiguous. On the one hand, as total market supply of

new offerings increases, it may be more difficult for the underwriter to search for the willing buyers; on the other hand, as recognized by Logue and Lindvall [26], the amount of new offerings in the market may reflect the investor's demand for investment, hence the underwriter's marketing effort may be eased as investor's demand increases. Thus, denote the size of the issue by y and the primary capital market condition by k, it is assumed that

$$\partial S/\partial y > 0 \qquad \partial S/\partial k > 0 \quad \text{or} \quad \partial S/\partial k < 0$$
$$\partial S'/\partial Y < 0, \qquad \partial S'/\partial k > 0 \qquad \partial S'/\partial k < 0.$$

Vector $\underline{f}$ also includes the size of the issue, as well as a measure of transfer agents cost and the costs of distributing shares to current owners. Since a portion of the firm's flotation cost is fixed, it is expected that economies of scale also exists with respect to flotation cost if the issuer's variable expenses do not exhibit sufficient offsetting diseconomies. If this is the case, the firm's marginal flotation cost will decrease as the size of the issue increases. It has been argued by Hansen and Pinkerton [19] that a higher ownership density is directly associated with a reduciton in the flotation cost of non-underwritten rights offering. In this study, a measure of ownership con-

centration will also be used to register issuer flotation costs and it is expected that the relationship between increased ownership concentration and the flotation cost is negative. From Beranek's discussion, the impact of increased transfer agent costs on the firm's flotation cost is obviously positive. Denote the ownership density by w and the transfer agent costs variable by T, then

$$\partial F/\partial y > 0 \qquad \partial F/\partial w < 0 \qquad \partial F/\partial T > 0$$
$$\partial F'/\partial y < 0, \qquad \partial F'/\partial w < 0, \qquad \partial F'/\partial T > 0.$$

Vector $\underline{q}$ includes the prevailing interest rate as well as a measure of the fees incurred by owners in their portfolio adjustment process. It is assumed that the owner's cost of subscription increases as the interest rate increases, as well as when the costs of portfolio adjustment increases. Denote the interest cost variable by i, then

$$\partial Q/\partial i > 0$$
$$\partial Q'/\partial i > 0.$$

Finally, a measure of the riskiness of the stock as well as the interest rate will enter into the risk premium through vector $\underline{r}$. It is straight forward to demonstrate that the risk premium is increasing in both the interest

rate and the riskiness of the stock. Denote the riskiness of the stock by e, then

$$\partial RP/\partial i > 0 \quad \text{and} \quad \partial RP/\partial e > 0.$$

Given the above assumptions, we can then derive hypotheses about the impact of each exogenous variable on the allocation ratio. A complete comparative statics analysis of the problem is offered in Appendix D.

4.2 THE EMPIRICAL MODEL

In addition to the dividend policy effects, the transfer agent cost effects, and the owner subscription cost effects, there are three sets of determinants that influence the allocation ratio decision. These include issue characteristics, firm characteristics, as well as primary capital market conditions. The following general specification of the empirical model will be used to test the relevant hypotheses:

$$N = N(\text{DIV POLICY; TRANSFER COST; OWNCOST VARS;}$$
$$\text{ISSUE VARS; FIRM VARS; CAPMKT VARS)},$$

the dependent variable, N, is the allocation ratio. The set of explanatory variables are discussed in turn in the following section.

4.2.1 The Explanatory Variables and their impact on the allocation ratio

In this section, the measurement of each of the explanatory variables in the above equation is suggested and the expected impact of these variables upon the level of the allocation ratio is discussed.

4.2.1.1 Dividend policy variable

According to Levy and Sarnat [24], the relationship between dividend policy cost and allocation ratio should be positive. To test this theory, the dividend policy factor, DIV POLICY, has to be measured. This measure, denoted by D, must reflect to some extent the reluctance of firms to change dividend policy such that when D increases, the cost of dividend policy increases. If dividend policy cost is higher, then according to Levy and Sarnat, the allocation ratio will increase thereby maintaining a higher future per share expected dividend, ceterus paribus.[12]

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[12] See Appendix C for the proof that $\partial N/\partial D > 0$.

Several reasons are given in the literature to explain why firms are reluctant to change dividends. These include the liquidity needs for investors, the informational content of dividends and certain legal considerations (Van Horne [41], Schnabel[37]). Because investors may view dividend as a source of funds to meet their current living expenses, it has been argued that these investors will value stable dividends and firms will therefore try to avoid unstable dividend payments. It has been argued that a stable dividend payment may convey to investors management's view about the future prospect of the firm, hence, in the absence of any changes in the firm's future prospects, management may again be reluctant to alter per share dividends in a significant way. Finally, it has been recognized that institutional investors such as pension funds and insurance companies are required by security regulations to invest in legally listed firms with uninterrupted dividends. A cut in the firm's dividend may result in the removal of this company from these legal lists.

The general idea that firms are reluctant to alter their per share dividends, hence there is a cost to changing per share dividend policy, is rejected by the arguments of Miller and Modigliani [34]. Miller and Modigliani argue that the value of the firm is unaffected by dividend policy, pri-

marily because the issuer can quickly offset dividend policy changes with the issuing of new capital. As noted by Levy and Sarnat, however, Miller and Modigliani do acknowledge the possibility of the existence of information content in dividend policy. In any event, the proprosed test of Levy and Sarnat's model of the allocation ratio decision is, indeed, an indirect test of the relevancy of dividend policy.

The measurement of the stability of dividend payments over time for a firm is one way to gauge that firm's reluctance to change dividend policy. That is, the more reluctant the firm is to change dividends, the more stable will be the firm's dividend payments over time, ceterus paribus. Of course, the degree of importance attached to dividend policy may be quite different across firms. Some firms may be more reluctant to change dividend payments than others. It is reasonable to assume, however, that other things being equal, the more important the dividend policy is to the firm the more costly it is to the firm to change its per share dividend level, hence the less likely that the firm is willing to cut its dividends following the rights offering. That is, ceterus paribus, the cost of the dividend policy will be higher for the firm with the higher indication of reluctance to change dividend policy. Several measures of the stability of dividend payments are suggested:

1. $D_i = \sqrt{\sum_{t=1}^{n} (d_{it} - \bar{d}_i)^2/(n - 1)}$

where d_{it} is the dividend per share for the ith firm in the period t and $\bar{d}_i$ is the mean of d_{it} over the n periods. D_i is the sample variance of the dividend payments. The lower is the variance, the more stable is the dividend policy and the higher is the cost of dividend. Thus the expected relationship between the variance of dividend and the allocation ratio is negative.

2. $D_i = s_d/\bar{d}_i = \sqrt{\sum_{t=1}^{n} (d_{it} - \bar{d}_i)^2/(n - 1)} / (\sum_t d_{it}/n)$

D_i is the coefficient of variation of the ith firm's dividend payments. A high D_i indicates relatively unstable dividend policy and it is expected, according to Levy and Sarnat, that the more unstable the dividend policy then the more likely is a cut in the firm's current level of dividend to meet future dividend payment after the rights offering.

3. $D_i = \gamma d_{it} E_{it}$

where E_{it} is the net income per share of firm i at time t, and $\gamma d_{it} E_{it}$ is the correlation coefficient between the net income and dividends per share of

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[13] For a discussion on the relationship between net income and dividend per share, the reader is referred to Fama and Babiak [16].

firm i at time t.[13]

A priori, it is not clear what would be the sign of this measure in the regression. It all depends on how the correlation coefficient is associated with the stability of the dividend payments. If higher correlation between income per share and dividend per share corresponds to more(less) stable dividend flows, then the relationship between this dividend policy variable and the allocation ratio should be positive(negative).

4. $D_i = \gamma d_{it} E_{it}$

In this case, D_i is the coefficient of autocorrelation in historical dividends. The higher is D_i, the higher is the cost of changing dividend. Thus the expected relationship between the autocorrelation coefficient and the allocation ratio is positive.

4.2.1.2   Transfer cost variable

According to Beranek [11], the relationship between the transfer cost variable, denoted by T, and the allocation ratio should be positive.[14] A firm with higher transfer cost

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[14] The analytics of comparative statics showing $\partial N/\partial T > 0$ is given in Section D.6 of Appendix D.

should choose a higher allocation ratio so that the number of shares issued, hence the volume of shares to be transferred, is reduced. The data for the cost of transferring share titles is not available, however, its magnitude may be indirectly reflected in the number of owners or the size of the firm.[15] The larger is the total number of current owners, the larger will be the number of stock titles requiring transfer, hence the higher will be the transfer agent fees, ceterus paribus. Similarly, the larger is the size of the firm, the larger will be the cost associated with administering the transfer of share titles.

4.2.1.3   The owner subscription cost variable

Other things being equal, the higher the cost of liquidity to owners, the higher is the subscription cost to owners. One measure of the owner's liquidity cost is the interest rate on short term treasury bills at the time of offering. If this is the only role that the interest rate would play in the model, a positive relationship between the interest rate and the allocation ratio would be hypothesized. The intuitive explanation is that, as owner's subscription cost

[15] The correlation coefficient between the number of owners and the total asset of the firm is 0.93 (significant at α =0.0001) for the sample firms.

increases, a larger allocation ratio is selected so that more shares are distributed through the relatively less costly underwriting syndicate. However, the interest rate also affects the risk premium charged by the underwriter. As the interest rate increases the risk premium increases and, in this case, a smaller allocation ratio should be selected. Thus, the final relationship between the interest rate and the allocation ratio is mixed, depending on the relative elasticities of the two cost functions (Appendix D.4 shows the comparative statics for this relationship).

The concentration of ownership can also be used to reflect the magnitude of owner's subscription cost. Due to the presence of a fixed cost to each owner of subscribing, the more concentrated is the firm's ownership the less costly it is per dollar subscribed to the owner. Thus, for example, the larger is the average number of shares possessed by each owner, the lower will be the cost per dollar subscribed to each owner and, ceterus paribus, if the subscription cost to owners decreases the firm should then select a lower allocation ratio to induce a larger amount of equity subscribed by owners. Thus, a negative relationship between the ownership density and the allocation ratio is hypothesized.

4.2.1.4   Issue variables

Issue specific variables include the size of the issue, and the riskiness of the stock. By comparative statics analysis, it can be shown that the direction of the impact of issue size on the allocation ratio is mixed (see Appendix D.1). Its direction depends on the relative effects of increased issue size on the underwriter's marginal distribution cost and the firm's marginal flotation cost. If the scale economies to marginal underwriter's distribution cost is greater than the scale economies to marginal firm's flotation cost, the coefficient of the issue size can be shown to be positive. That is, the firm is willing to increase the allocation ratio for larger size of issue if the decrease in underwriter's marginal distribution cost due to economies of scale dominates. In this case, the rate of subscription decreases and a larger proportion of the issue will be distributed by underwriters.

The relationship between the riskness of the issue and the allocation ratio is expected to be ambiguous ex ante. Other things being equal, a riskier issue will require higher underwriting risk premium, the allocation ratio is therefore expected to be lowered to reduce the risk of undersubscription, hence, the cost of underwriting (see Appendix D.2). From equation (21), it is straight forward to demons-

trate that the underwriter's risk premium is increasing in the variance of the rate of return on stock. On the other hand, from the concavity of management's utility function, it is clear that expected utility is inversely related to a mean preserving increase in the variance of wealth. Thus, in the case of a riskier issue, management will want to shift more of the risk bearing burden to the underwriter by choosing a higher allocation ratio.[16] That is, the management acts as if there is a risk premium imputed in the firm's cost, and that risk premium increases as issue risk increases. This positive impact of risk on the allocation ratio offsets the negative impact of risk on the allocation ratio due to the underwriter's risk premium, hence the ambiguous effect of increased risk on the allocation ratio. As usual, the variance of the rate of return on the stock is used to measure the riskiness of the stock.

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[16] It has been proved in Chapter 3 that
$$\partial I_0 / \partial N < 0 \text{ and } \partial I_j / \partial I_0 < 0;$$
since the unsubscribed shares are distributed by the firm as well as the underwriter, a unit decrease in I_0 will not result in the same unit increase in I_j, therefore,
$$-1 < \partial I_j / \partial I_0 < 0.$$
Thus, $\partial(I - I_0 - I_j)/\partial N = -(\partial I_0/\partial N)(1 + \partial I_j/\partial I_0) > 0.$
That is, the amount of shares distributed by the underwriter increases as the allocation ratio increases.

4.2.1.5 Firm variables

The primary firm variables are the concentration of ownership and issue size. It is hypothesized that, ceterus paribus, as the ownership concentration increases, the marginal flotation cost of the firm decreases, consequently, a highly concentrated firm ownership is expected to be associated with a lower allocation ratio (See Appendix D.3). It should be noted that this inverse relation is further supported in the previous disscussion in which it was argued that increased ownership concentration also lowered owner's subscription cost. Similarly, a negative relationship between the issue size and the marginal flotation cost would lead to a negative relationship between the issue size and the allocation ratio; however, as mentioned previously the issue size also affects the underwriter's cost, therefore the net effect of size on the allocation ratio is ambiguous (see Appendix D.1).

4.2.1.6 Capital market variables

There are several measures that can be used to reflect primary capital market activity. Examples of these are both the total dollar value of and the number of all new capital issues offered, and both the total dollar value of and the

number of new equity issues offered around the issue date.
From the model developed in Chapter III, the higher is the
underwriter's distribution cost, the lower will be the allo-
cation ratio. However, as discussed in Section 4.1, the ef-
fect of capital market on distribution cost is ambiguous.
Thus the impact of capital market variable on the allocation
ratio is indeterminant, a priori (Appendix D.5 shows the re-
sult of the comparative statics in this regard).

4.2.2   The Data and the Formation of Variables

   The data to be used in this study consists of all standby
rights offerings issued beween January 1968 and December
1979, for firms from which a copy of the offering prospectus
could be obtained. This sample consists of 123 standby
rights issues, including 97 utilities, 17 industrials and 9
financial companies. With respect to the forms of under-
writing contract, 96 are two-fee contracts and 27 are sin-
gle-fee contracts. Only 17 offerings were made on the basis
of competitive bid, with the remaining 112 awarded through a
negotiated offering. Table 3 exhibits the different types
of sample observations. As shown in the Table, the largest
number of observations is in the category of negotiated,
split-fee underwritten rights offerings for utility compa-
nies.

TABLE 3

Rights Offerings by Types

TYPE	FREQUENCY
Negotiated Split-fee Utility	66
Bid Split-fee Utility	6
Negotiated Split-fee Industrial	15
Negotiated Split-fee Financial	9
Negotiated Level-fee Utility	14
Bid Level-fee Utility	11
Negotiated Level-fee Industrial	2

The monthly data of dividend per share and earnings per share for six years before and four years after the month of offering are obtained for the sample firms from the Compustat PDE tape, from which the quarterly figures are generated and they serve as the basis for computing the four alternative dividend policy variables. The terms to be used in the analysis are defined below, with their hypothesized signs given in parentheses.

VDIV(-) = the variance of quarterly dividends per share,

DIVCV(+) = the coefficient of variation of quarterly dividends per share,

AUTO(+) = the autocorrelation coefficient of quarterly dividends per share.

COR(+) = the correlation coefficient of quarterly dividends per share and earnings per share,[17]

The number of owners and the total asset of the issuing firms are used as alternative measures of the transfer cost variable discussed in Section 4.2.1.2:

NUMOWN(+) = total number of owners at the time of offering,

TA(+) = total asset in real terms at the time

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[17] A test of correlation indicates that the correlation coefficient between COR and VDIV is -0.25 (significant at α = 0.02), thus a higher COR is associated with lower variance of dividends, which in turn implies higher cost of dividend and one would expect to see a larger allocation ratio.

of offering.

The T-Bill rate and the average number of new shares per shareholder measuring the liquidity cost and the ownership concentration respectively, serve as the two owner subscription cost variables:

RTB(mixed) = the real average daily T-Bill rate one
month before the offering date,

OWNSHR(-) = (1-INST-BOD)NS/NUMOWN

= the average number of new shares for
each shareholder,

where INST is the percentage of shares held by institutions,

BOD is the percentage of shares held by the Board,

NS is the total number of shares issued.

The two issue specific variables discussed in Section 4.2.1.4 are represented by the natural logarithm of the issue size (in real terms) and the variance of the weekly rate of return during the period 115 days before to 25 days before the issue date:

LnSIZE(mixed) = the natural logarithm of real issue size
in millions of dollars,

VARIANCE(mixed) = the annualized variance of twenty
weekly holding period returns from 115
days before to 25 days before the
offering date.

The firm variables are indicated by the ownership density measure, OWNSHR, and the size measure, LnSIZE.

Finally, the total number of contracts underwritten and the total dollar of all issues underwritten from one month before to the month of offering are used to measure capital market activity:

UND(mixed) = total number of underwritten contracts,

CAP(mixed) = total dollar issued in real terms.

4.2.3 The Results

The regression equation to be estimated basically takes the following form:

$$ALCRAT_i = b_0 + b_1 VARIANCE_i + b_2 CAP_i + b_3 OWNSHR_i + b_4 LnSIZE_i$$
$$+ b_5 RTB_i + b_6 COR_i + b_7 NUMOWN_i$$

where $ALCRAT_i$ is the allocation ratio for firm i and the independent variables are as explained in the previous section.

Due to insufficient information, two subgroups, the negotiated, split-fee financials and the negotiated, level-fee industrials, have been eliminated from the analysis. After further screening, more observations have been deleted because of incomplete information and the effective sample

PERCENTAGE

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        |                        ***
        |                        ***
        |                        ***
     50 +                        ***
        |                        ***
        |                        ***
        |                        ***
        |                        ***
     40 +                        ***
        |                        ***
        |                        ***
        |                        ***
        |                        ***
     30 +                        ***
        |                        ***
        |                        ***
        |                        ***
        |                        ***
     20 +                        ***
        |                        ***
        |              ***       ***       ***
        |              ***       ***       ***
        |              ***       ***       ***
     10 +              ***       ***       ***
        |              ***       ***       ***
        |    ***       ***       ***       ***       ***
        |    ***       ***       ***       ***       ***
        |    ***       ***       ***       ***       ***       ***       ***
        ----------------------------------------------------------------
             4         8        12        16        20        24        28
```
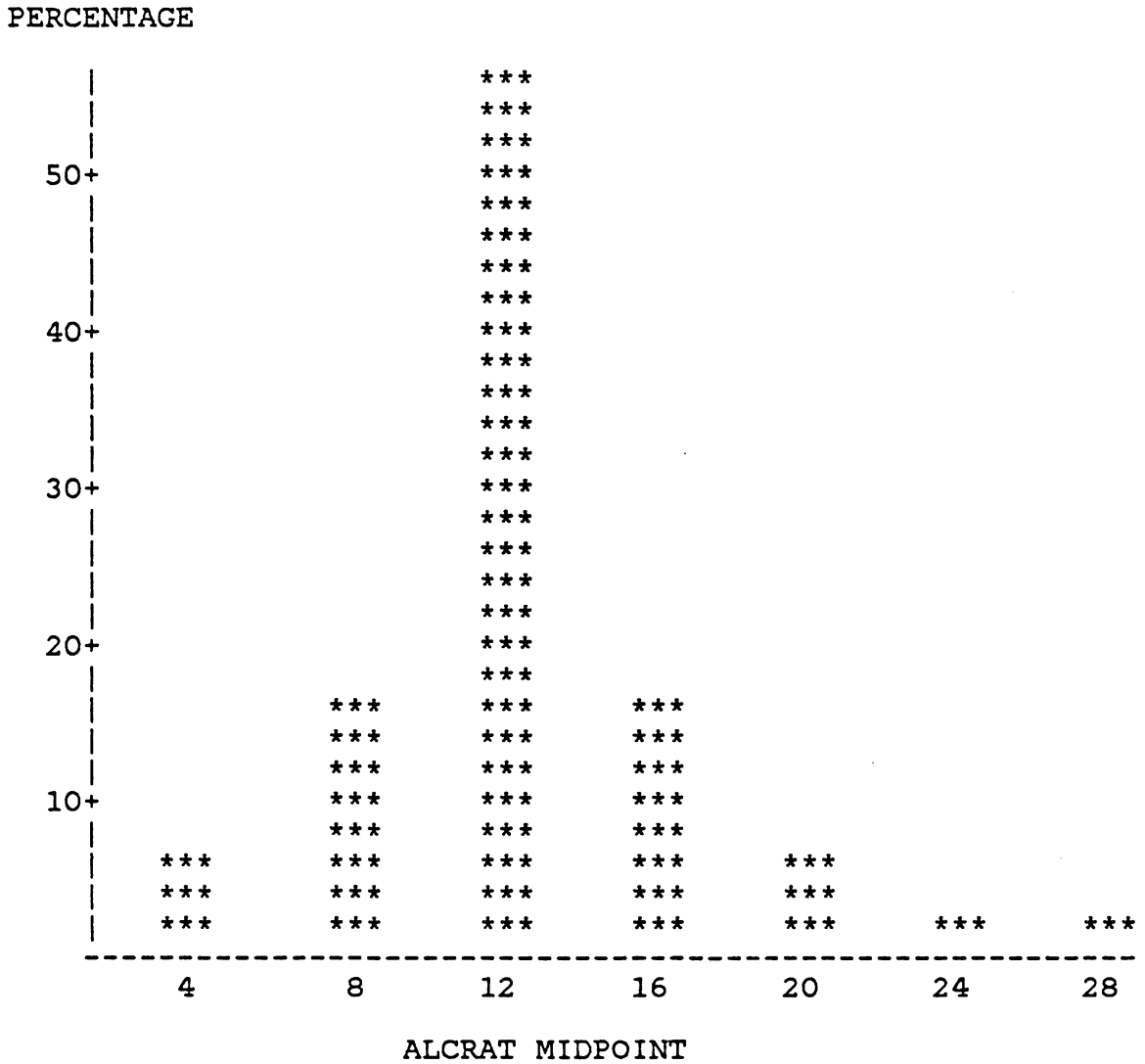
ALCRAT MIDPOINT

Figure 15: The Distribution of The Allocation Ratio

size reduced to a total of seventy-eight observations. The distribution of the allocation ratio for the effective sample is exhibited in Figure 15.

Among those remaining there are 49 negotiated, split-fee utilities(NSU), 6 competitive bid, split-fee utilities(BSU), 6 negotiated split industrials(NSI), 10 negotiated, level-fee utilities(NLU) and 8 competitive bid, level-fee utilities(BLU).

Except for the NSU's, all subsamples are very small. One way of handling this problem of insufficient degrees of freedom is to pool as many observations as possible of these small subsamples for the regression analysis so that the efficiency of the estimators may be improved. However, it would be improper to simply aggregate the subsamples which come from different populations. A series of Chow's test are therefore performed to test for the equality of regression coefficients when different samples are used to estimate the same equation. Specifically, the following F statistic tests the hypothesis that the n_2 observations in subsample 2 are based on the same population as subsample 1 of n_1 observations:

$$F = [(SSE - SSE_1)/n_2] / [SSE_1/(n_1 - k)] \sim F(n_2, n_1 - k)$$

where SSE = the sum of squares of residuals for the
aggregated sample,

SSE_1 = the sum of squares of residuals for subsample 1,

n_1 = the number of observations in subsample 1,

n_2 = the number of observations in subsample 2,

k = the number of parameters to be estimated.

A significant F indicates that the subsamples tested are drawn from different populations and they can not be pooled for the analysis. The tests proceed sequentially in the following order:

1. negotiated split-fee utility vs. negotiated level-fee utilities,

2. negotiated split-fee and negotiated level-fee utilities vs. bid split-fee utilities,

3. negotiated split-fee utilities, negotiated level-fee utilities, bid split-fee utilities vs. bid level-fee utilities,

4. negotiated split-fee, negotiated level-fee, bid split-fee and bid level-fee utilities vs. negotiated split industrials.

If step 1 passes the F test (that is, having an insignificant F) then step 2 continues; likewise, step 3 proceeds if step 2 passes and step 4 proceeds if step 3 passes the F test. Furthermore, the data is divided into the following groups to test if there is any difference between the negotiated offerings and the competitive bid offerings:

5. negotiated level-fee utilities vs. bid level-fee

utilities,

6. negotiated split-fee utilities vs. bid split-fee
   utilities,

7. negotiated split-fee and negotiated level-fee
   utilities vs. bid split-fee and bid level-fee
   utilities.

The results of the Chow's test are exhibited in Table 4.
Only the test between utilities and industrials yields a
significant F value.

There is no significant difference between the negotiated
groups and the competitive bid groups, nor is there any sig-
nificant difference between the level-fee groups and the
split-fee groups. In other words, the hypothesis that all
of the utility subsamples, be it level-fee or split-fee, ne-
gotiated or bid, are from the same population is not reject-
ed, hence they can be merged as one sample. On the other
hand, the significant F in row (4) implies that the utili-
ties and the industrials are drawn from different popula-
tions, hence they should be estimated separately. Unfortu-
nately, there are not enough data points left to estimate
for the industrial subsample, thus only the regression re-
sults for the utilities will be reported in this study.

A least squares estimation technique is employed to esti-
mate the parameters. The major regression results are pre-

TABLE 4

The Results of Chow Tests

SUBSAMPLES	SSE	SSE_1	n_1-k	n_2	F	$F_{0.95}$
1.NSU vs. NLU	530.99	456.61	41	10	0.67	2.08
2.NSU,NLU vs. BSU	552.78	530.99	51	6	0.35	2.30
3.NSU,NLU,BSU vs. BLU	599.69	552.78	57	8	0.60	2.12
4.NSU,NLU,BSU,BLU vs. NSI	974.56	599.69	65	6	6.77*	2.25
5.NLU vs. BLU	51.05	22.83	2	8	0.31	19.37
6.NSU vs. BSU	473.08	456.61	41	6	0.24	2.34
7.NSU,NLU vs. BSU,BLU	599.69	530.99	51	14	0.47	1.90

sented in Table 5, 6, 7, 8, and 9. A simple correlation matrix is exhibited in Table 13.

The results of the estimated equations using alternative measures of dividend policy DIVCV, AUTO, and COR, are given in Table 5, 6, and 7, respectively.[18] Table 8 exhibits the result when UND is substituted for CAP, and Table 9 gives the result when TA is substituted for NUMOWN. A comparison of Tables 5, 6, and 7 reveals that COR is a better measure of dividend policy than the other measures (although not shown here, the analysis of variance indicates that COR reduces more residual sum of squares than any of the other alternative measure), thus COR is kept for use in the remaining equations. Similarly, by comparing Tables 7 and 8, we find that CAP performs better than UND, thus CAP is kept in the remaining equations. Overall, The regression equation in Table 9 gives the best fit. The residual plot of the last equation is depicted in Figure 16.

In general, the signs of the independent variables are significant and consistent with the hypotheses. In particular, the sign of the ownership density measure, OWNSHR, is significantly negative and the signs of the transfer cost measures, TA and NUMOWN, are significantly positive across

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[18] The regression result when VDIV is used is very similar to the result when DIVCV is used(Table 5), hence it is not shown here to avoid redundance.

all regression equations.

For the dividend policy variable, although AUTO and DIVCV are insignificant, COR does appear significantly positive. As mentioned in footnote 16, this is consistent with Levy and Sarnat's dividend cost hypothesis; the significant result implies that a firm which places more weight on the importance of dividend policy tends to choose a higher allocation ratio.

The sign of LnSIZE is significantly negative in all equations. Following the analysis in Section 4.2.1.4, the impact of the issue size depends on the relative scale economies of the underwriter and the issuer. The significant negative result implies that the marginal flotation cost of the firm decreases as issue size increases, and the firm's scale economies overides the underwriter's scale economies in the determination of the allocation ratio. The net result is a lower allocation ratio as issue size increases.

The real T-Bill rate is consistently positive and significant in two cases. Recall from the discussion in Section 4.2.1.3 that the subscription cost will positively affect the determination of the allocation ratio while the risk premium will inversely affect the allocation ratio, thus the impact of the T-Bill rate on allocation ratio is expected to be mixed. The insignificant result in Table 5, 6 and 8 can

be due to either the counteracting effect of the two forces
mentioned above, or the correlation of T-Bill rate with in-
dependent variables (see Table 13). In order to improve the
efficiency of the estimators, three equations are estimated,
each having one independent variable dropped from the re-
gression. Table 10, 11, and 12 exhibit the results when
COR, OWNSHR, and VAR, respectively, are dropped from the re-
gression equation. Although the omitting of important vari-
ables could increase the bias of estimation, the variance of
the estimators is reduced and RTB becomes significant in all
three equations.[19] In any case, the positive sign of T-Bill
rate suggests that the owner's subscription cost effect is
overiding the risk premium effect so that the net effect on
the allocation ratio becomes positive.

The capital market variables CAP has a negative sign in
all cases but are insignificant. This insignificant result
may be caused by its correlation with the T-Bill rate (see
Table 13). Despite the low t statistics for CAP, the nega-
tive sign suggests that the greater is the capital market
activity, the higher will be underwriter's cost of distribu-
tion which leads to a lower allocation ratio.

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[19] Note that the number of observations available for esti-
mation increases to 81 in Table 10 and 11, and 76 in Ta-
ble 12 due to the omission of otherwise needed informa-
tion on COR, OWNSHR and VARIANCE. The increase in the
degrees of freedom also aids the improvement of efficien-
cy.

Finally, the variance of the rate of return has a positive, but insignificant sign in all cases.

While an ambiguous effect of variance upon the allocation ratio was expected, there remains the possibility that the distribution of the rate of return for the issuing firm may shift before the offering, therefore, the variance of the rate of return before the offering may not be an appropriate measure for the riskiness of the stock.[20] In order to control for this particular price behavior before the rights offerings, the coefficient of variation (COEVAR) which takes into account the changes in mean returns is substituted for variance to re-estimate the regression equations. The results are also exhibited in Table 5 through Table 12. In contrast with the results with VARIANCE, the sign of the risk measure, COEVAR, is unanimously negative, though not significant.[21] Note, however, that COEVAR explains more of the variation in allocation ratio than VARIANCE does, as re-

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[20] In their well-known study on stock split, Fama, Fisher, Jensen and Roll [17] find that the average residuals in the 29 months prior to a split are uniformly positive; the highest average monthly return occurs in the few months immediately preceding the split. As rights offerings have many similarities with stock splits, their result have important implications for the rights offerings. The quasi-split effect of stock rights is confirmed by Nelson's study [35], in which positive residuals are found for the 6 months before the announcement of rights offerings.

[21] The simple correlation coefficient between the allocation ratio and COEVAR is -0.195, significant at $\alpha = 0.10$.

flected by the slight improvement in R^2 and the stronger t statistics.

TABLE 5

The Regression Results When DIVCV Is the Dividend Policy
Variable

INDEPENDENT VARIABLES	(1)	(2)
VARIANCE	1.76649(0.25)	-------------
COEVAR	------------	-0.00078(-1.42)
CAP	-0.00062(-1.25)	-0.00061(-1.27)
OWNSHR	-0.05071(-2.45)*	-0.04981(-2.44)*
LnSIZE	-1.33732(-1.75)*	-1.41449(-1.91)*
RTB	0.38217(1.50)	0.35985(1.44)
DIVCV	0.01240(0.39)	0.00820(0.28)
NUMOWN	2.16E-05(2.10)*	2.15E-05(2.17)*
INTERCEPT	16.86881(6.94)*	17.31516(7.18)*
R^2	0.3002	0.3206
F	3.98	4.38
OBS	73	73

* significant at $\alpha = 0.10$ or better.

TABLE 6

The Regression Results When AUTO is the Dividend Policy
Variable

INDEPENDENT VARIABLES	(1)	(2)
VARIANCE	2.98238(0.44)	-------------
COEVAR	-----------	-0.00079(-1.46)
CAP	-0.00073(-1.49)	-0.00069(-1.44)
OWNSHR	-0.05580(-2.62)*	-0.05425(-2.58)*
LnSIZE	-1.28278(-1.70)*	-1.38760(-1.88)*
RTB	0.42046(1.65)	0.39318(1.56)
AUTO	0.69280(0.79)	0.61934(0.72)
NUMOWN	2.00E-05(1.98)*	2.05E-05(2.09)*
INTERCEPT	17.19502(7.48)*	17.59167(7.88)*
R^2	0.3052	0.3251
F	4.08	4.47
OBS	73	73

TABLE 7

The Regression Results When COR is the Dividend Policy
Variable

INDEPENDENT VARIABLES	(1)	(2)
VARIANCE	1.52172(0.23)	-------------
COEVAR	-------------	-0.00061(-1.11)
CAP	-0.00066(-1.39)	-0.00064(-1.37)
OWNSHR	-0.03911(-1.85)*	-0.03972(-1.89)*
LnSIZE	-1.56414(-2.08)*	-1.60234(-2.17)*
RTB	0.43431(1.76)*	0.40938(1.66)
COR	2.08778(1.89)*	1.83515(1.64)
NUMOWN	2.66E-05(2.58)*	2.60E-05(2.59)*
INTERCEPT	16.23113(7.05)*	16.61467(7.32)*
R^2	0.3349	0.3468
F	4.68	4.93
OBS	73	73

TABLE 8

The Regression Results When UND is the Capital Market
Variable

INDEPENDENT VARIABLES	(1)	(2)
VARIANCE	1.20505(0.18)	--------------
COEVAR	-------------	-0.00062(-1.13)
UND	0.00582(0.75)	0.00569(0.75)
OWNSHR	-0.03646(-1.59)	-0.03713(-1.64)
LnSIZE	-1.67925(-2.21)*	-1.70983(-2.28)*
RTB	0.28886(1.06)	0.26599(0.99)
COR	2.36071(2.02)*	2.09115(1.77)*
NUMOWN	3.07E-05(2.83)*	2.99E-05(2.79)*
INTERCEPT	13.44846(5.51)*	13.88928(5.98)*
R^2	0.3210	0.3337
F	4.39	4.65
OBS	73	73

TABLE 9

The Regression Results When TA Is the Transfer Cost Variable

INDEPENDENT VARIABLES	(1)	(2)
VARIANCE	1.07178(0.18)	--------------
COEVAR	-------------	-0.00057(-1.13)
CAP	-0.00053(-1.19)	-0.00051(-1.18)
OWNSHR	-0.04151(-2.30)*	-0.04175(-2.34)*
LnSIZE	-2.50083(-3.44)*	-2.53372(-3.54)*
RTB	0.37625(1.72)*	0.35515(1.63)
COR	2.10309(2.09)*	1.86724(1.83)*
TA	0.00195(4.17)*	0.00192(4.19)*
INTERCEPT	18.42411(8.16)*	18.74976(8.44)*
R^2	0.4217	0.4325
F	6.77	7.08
OBS	73	73
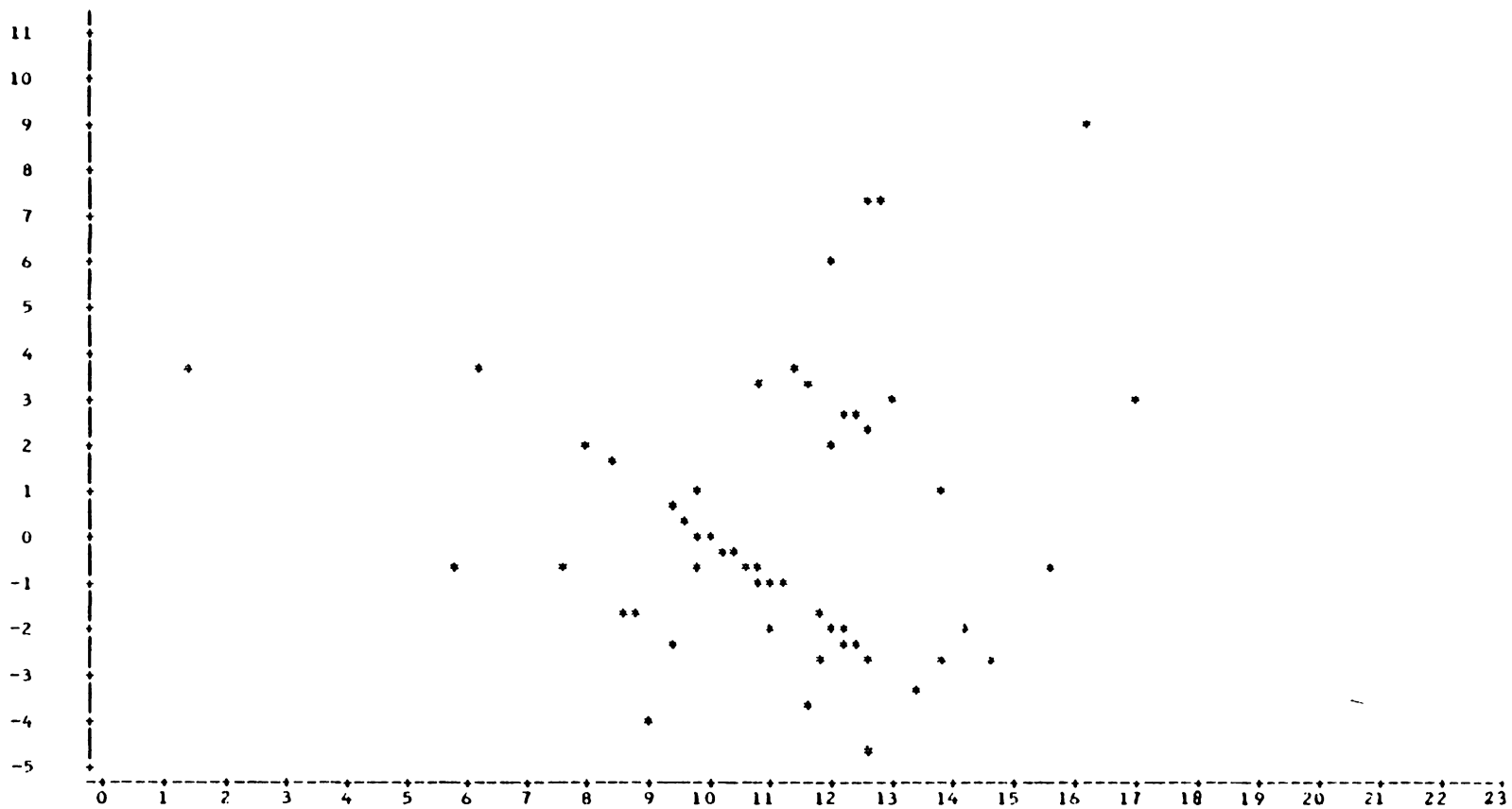
Figure 16: The Plot of Residuals against the Predicted Values

TABLE 10

The Regression Results When COR Is Dropped from the Model

INDEPENDENT VARIABLES	(1)	(2)
VARIANCE	3.20512(0.52)	--------------
COEVAR	--------------	-0.00074(-1.46)
CAP	-0.00069(1.64)	-0.00063(-1.53)
OWNSHR	-0.05691(-3.54)*	-0.05653(-3.56)*
LnSIZE	-1.20681(-2.08)*	-1.28706(-2.26)*
RTB	0.44284(2.02)*	0.41912(1.93)*
TA	0.00129(3.07)*	0.00130(3.18)*
INTERCEPT	16.79555(8.44)*	17.07358(8.77)*
R^2	0.3806	0.3958
F	7.58	8.08
OBS	81	81

TABLE 11

The Regression Results When OWNSHR Is Dropped from the Model

INDEPENDENT VARIABLES	(1)	(2)
VARIANCE	4.77697(0.78)	--------------
COEVAR	------------	-0.00053(-1.01)
CAP	-0.00093(-2.21)*	-0.00090(-2.15)*
LnSIZE	-1.72747(-3.64)*	-1.72849(-3.65)*
RTB	0.40676(1.86)*	0.38756(1.77)*
COR	2.56490(2.72)*	2.45484(2.58)*
TA	0.00167(4.55)*	0.00166(4.52)*
INTERCEPT	15.61601(8.82)*	15.88715(9.03)*
R^2	0.3272	0.3308
F	5.92	6.02
OBS	81	81

TABLE 12

The Regression Results When VARIANCE Is Dropped from the Model

INDEPENDENT VARIABLES	ESTIMATED COEFFICIENTS	T
CAP	-0.00067	-1.51
OWNSHR	-0.04652	-2.52*
LnSIZE	-2.37188	-3.18*
RTB	0.43490	1.92*
COR	2.02067	2.02*
TA	0.00185	3.92*
INTERCEPT	18.93083	8.43*
R^2		0.4023
F		7.74
OBS		76

TABLE 13

The Correlation Matrix for the Utility Samples

	ALC-RAT	VARI-ANCE	CAP	UND	OWN-SHR	Ln-SIZE	RTB	COR	NUM-OWN	TA
ALC RAT-	1.00	.11	-.22	-.09	-.46	-.03	.09	.21	.21	.25
VARI-ANCE		1.00	.08	-.14	-.11	.01	.01	.05	.12	.09
CAP			1.00	.09	.18	-.12	.23	.01	-.24	-.23
UND				1.00	-.21	-.35	.56	-.06	-.42	-.38
OWN-SHR					1.00	.03	-.08	-.19	-.25	-.15
Ln-SIZE						1.00	-.32	-.12	.79	.83
RTB							1.00	.08	-.42	-.36
COR								1.00	-.19	-.17
NUM-OWN									1.00	.93
TA										1.00

4.3   SUMMARY AND CONCLUSION

The theoretical model developed in this study distin-
guishes the various cost components associated with a rights
offering and argues that the optimal allocation ratio is
that which maximizes the expected utility of management. By
explicitly taking into account the cost factors in rights
offerings, the theoretical model refutes the idea that the
issue price can be costlessly set arbitrarily low to elimi-
nate the risk of undersubscription. The model also explains
why we would expect to observe less than one hundred percent
subscription rate even when the value of a right is posi-
tive: owners incur costs in subscribing to shares, therefore
they will exercise the rights only when the gain from sub-
scription is greater than the costs of subscription. In ad-
dition, the model explains why a rational risk neutral firm
may pay an underwriting risk premium: firms incur distribu-
tion costs in marketing their issues, as long as the cost of
underwriting is lower than the costs incurred by the firm,
it pays for the firm to pay the underwriting risk premium.
It is reasoned that an increase in the firm's flotation cost
and/or the owner's subscription cost will raise the alloca-
tion ratio while an increase in the syndicate's cost will
lower the allocation ratio. Accordingly, the determination
of allocation ratio is hypothesized to be influenced either

positively or negatively by a number of exogenous variables through their impact on these respective cost components.

The empirical results are, in general, interesting and important. According to the results of the empirical tests, Levy and Sarnat's dividend cost hypothesis can not be rejected: there is evidence of a positive relationship between the stability of the firm's dividend policy and the allocation ratio. In other words, the idea that future dividend payments do play a role in the determination of allocation ratio such that the more stable is the dividend flows the less shares will be issued to maintain existing per share dividend can not be rejected. The finding of the significance of dividend policy is not in congruence with the M&M dividend irrelevant theory. The result also confirms the significance of the cost of administering title transfer in the determination of the allocation ratio. It is found that the larger is the magnitude of transfer cost, the higher will be the allocation ratio. The significant result for the transfer cost measure offers support to Beranek's transfer cost hypothesis as well as the flotation cost effect analyzed in the theoretical model, where transfer cost is recognized as a part of the firm's flotation cost. A third important empirical finding is the significance of the owner's subscription cost in the allocation ratio deci-

sion. The results shows that the allocation ratio will increase if the cost of subscription increases, as is predicted by the theoretical model. The significant positive result of the liquity cost measure (RTB) lends further support to the significance of owner's subscription cost in the determination of allocation ratio. The impact of the size of the issue on the allocation ratio is significantly negative. This suggests the existence of scale economies to the firm's flotation cost. The result of the intensiveness of capital market activity is not as significant. A possible explanation lies in its correlation with other variables. In any event, the sign of the capital market activities is consistently negative. The result of VARIANCE is positive and insignificant. However, when the shift in the distribution of the rate of return is controlled by using the coefficient of variation instead of variance, the risk measure becomes negative. The negative sign of COEVAR supports the existence of a direct relationship between the issue risk and the underwriter's fees.

Although the empirical results are satisfactory at large, there are still many areas worthy of further investigation. For example, the moderate R^2 suggests the possible existence of other factors that may also enter into the determination of allocation ratio. Better measures of the independent va-

riables may improve the estimations. Finally, further modification is needed to extend the model to all underwritten offerings, including the case of firm committment contracts.

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Appendix A

A PROOF OF THE POSITIVE RELATIONSHIP BETWEEN THE RISK PREMIUM AND THE ALLOCATION RATIO

It has been shown by equation (21) that

$$RP = Ie^{-rT}N(-d_1) - (n_0 P_0/N)N(-d_2), \qquad (A1)$$

where $d_1 = [\ln(P_0/P_S)+(r+ \sigma^2/2)T]/\sigma\sqrt{T}$,

$$d_2 = [\ln(p_0/P_S)+(r- \sigma^2/2)T]/\sigma\sqrt{T}. \qquad (A2)$$

thus, $d_2 = d_1 - \sigma\sqrt{T}.$ $\qquad (A3)$

By definition, the cummulative normal function is

$$N(-d_i) = \int_{-\infty}^{-d_i} f(z)dz,$$

where $f(-d_i) = e^{d_i^2/2}/\sqrt{2\pi}$. $\qquad (A4)$

The partial derivative of the c.n.f. with N is

$$\partial N(-d_i)/\partial N = \int_{-\infty}^{-d_i} [\partial f(z)/\partial N]dz - (\partial d_i/\partial N)f(-d_i) + (\partial\infty/\partial N)f(-\infty)$$

$$= -(\partial d_i/\partial N)f(-d_i). \qquad (A5)$$

Furthermore, from (A3) it is clear that

$$\partial d_1/\partial N = \partial d_2/\partial N. \qquad (A6)$$

Thus, the partial derivative of RP with respect to N can be expressed as

$$\partial RP/\partial N = Ie^{-rT}[\partial N(-d_1)/\partial N] + n_0 P_0 N(-d_2)/N^2$$

$$- (n_0 P_0/N)\partial N(-d_2)/\partial N$$

$$= Ie^{-rT}(-\partial d_1/\partial N)f(-d_1) - (n_0 P_0/N)(-\partial d_2/\partial N)f(-d_2)$$

$$+ n_0 P_0 N(-d_2)/N^2$$

$$= (I/\sqrt{2\pi})[e^{-rT}(-\partial d_1/\partial N)e^{d_1^2/2} - (P_0/P_S)(-\partial d_2/\partial N)e^{d_2^2/2}]$$

$$+ n_0 P_0 N(-d_2)/N^2$$

$$= [(I\,\partial d_1/\partial N)/\sqrt{2\pi}][-e^{-rT}e^{d_1^2/2} + (P_0/P_S)e^{d_2^2/2}]$$

$$+ n_0 P_0 N(-d_2)/N^2$$

$$= [(I\,\partial d_1/\partial N)/\sqrt{2\pi}][-e^{-rT+d_1^2/2} + e^{\ln(P_0/P_S)+d_2^2/2}]$$

$$+ n_0 P_0 N(-d_2)/N^2 \qquad\qquad (A7)$$

From (A2) we obtain

$$d_1^2/2 - rt = \ln(p_0/P_S) + d_2^2/2,$$

therefore,

$$-e^{-rT+d_1^2/2} + e^{\ln(P_0/P_S)+d_2^2/2} = 0$$

and

$$\partial RP/\partial N = n_0 P_0 N(-d_2)/N^2 > 0. \qquad \text{Q.E.D.}$$

That is, the risk premium increases(decreases) as the allo-
cation ratio increases(decreases).

Appendix B

SIGNING THE COVARIANCE TERM

From Figure 14, it can be observed that the difference between the marginal syndicate's distribution cost and the marginal internal flotation costs to shareholders, $S'-F'-Q'$, decreases as the amount of equity subscribed by owners (I_0) increases, it is positive before the intersection point, zero at the point of intersection and increasingly negative as I_0 continues to increase. By the analysis in Section 3.3., we also known that $\partial I_0/\partial N < 0$. Thus, it is straight forward to demonstrate that

$$\partial[(S'-F'-Q')(\partial I_0/\partial N)]/\partial X > 0 \qquad (B1)$$

Furthermore, following a similar approach as Baron's [3], $[(S'-F'-Q')(\partial I_0/\partial N)]$ can be shown to equal the marginal risk premium of the firm. Define ΔW_1 to be the maximum amount that the firm would pay to avoid the risk and obtain with certain the expected value of W_1, then

$$\Delta W_1 = E(W_1) - U^{-1}[EU(W_1)], \qquad (B2)$$

where U^{-1} is the inverse of the utility function, ΔW_1 is positive for risk aversion. Equation (B2) also implies that the expected utility equals the utility of expected wealth less the risk premium:

$$U_1 [E(W_1)-\Delta W_1) = EU(W_1).\tag{B3}$$

Differentiating (B3) and evaluating the derivative at the optimal N yields

$$dU_1[E(W_1)-\Delta W_1]/dN = [(S'-F'-Q')(\partial I_0/\partial N)]-(d\Delta W_1/dN)]U_1' = 0,$$

hence

$$(S'-F'-Q')(\partial I_0/\partial N) = d\Delta W_1/dN = MRP_F.\tag{B4}$$

where MRP_F is the firm's marginal risk premium due to changes in the allocation ratio.

The direction of the derivative of U_1' with respect to X can be positive or negative. To sign $\partial U_1'(W_1)/\partial X$, we have to first sign $\partial(W_1)/\partial X$:

$$\partial W_1/\partial X = 1 + (S'-F'-Q')(\partial I_0/\partial X).\tag{B5}$$

Define X_e to be the level of future earnings where

$$F'[I_0(N,X_e)] + Q'[I_0(N,X_e)] = S'[I-I_0(N,X_e)-I_i(N,X_e)],\tag{B6}$$

then, from X_1 to X_e,

$$S' > F' + Q',$$

hence

$$\partial W_1/\partial X > 0.$$

Since $U'' < 0$, the above inequality implies

$$\partial U'/\partial X < 0. \tag{B7}$$

Thus, over this set of earnings, $[X_1, X_e]$, the covariance term in equation (53) is negative.

From X_e to X_3, the derivative of W_1 with respect to X is negative if the following condition holds:

$$(F'+Q'-S')(dI_0/dX) > 1, \tag{B8}$$

In this case,

$$\partial W_1/\partial X < 0, \quad \partial U'/\partial X > 0 \tag{B9}$$

thus the covariance term can be positive for higher levels of future earnings.

Appendix C

EMPIRICAL IMPLICATION OF LEVY AND SARNAT'S MODEL

Recall from Section 2.4.3. that Levy and Sarnat attibute the costs in a rights offering to (1) the direct cost of underwriting, and (2) the indirect dividend cost; where

$$Y(N) = a_0 + b_0(1/k) \qquad \text{(direct underwriting cost)}$$

$$D(N) = a_1 + b_1(R/P_1). \qquad \text{(indirect dividend cost)}$$

The optimal allocation ratio minimizes the total costs in a rights offering:

$$\text{Min } T(N) = Y(N) + D(N)$$
$$N$$

The first-order conditions of this problem are

$$Y'(N) = 0$$

and

$$D'(N) = 0.$$

The second-order condition, denoted by H, is positive in this case

$$H = \partial T'/\partial N > 0. \qquad \text{(B1)}$$

where T' is the derivative of total cost with respect to the allocation ratio. By comparative statics, the derivative of the allocation ratio with respect to the dividend policy variable, D, is

$$\partial N/\partial D = - (1/H)(\partial T'/\partial D) \tag{B2}$$

furthermore,

$$\partial T'/\partial D = \partial Y'(N)/\partial D + \partial D'(N)/\partial D = \partial D'(N)/\partial D.$$

Substituting the value of one right into D(N), it is straight forward to demonstrate that $\partial D(N)/\partial N < 0$; furthermore, by definition $\partial D(N)/\partial D > 0$, thus

$$\partial D'(N)/\partial D < 0$$

and $\tag{B3}$

$$\partial T'/\partial D < 0.$$

Finally, from (B1), (B2), and (B3)

$$\partial N/\partial D > 0.$$

That is, ceterus paribus, the allocation ratio increases as the dividend cost increases.

Appendix D

THE COMPARATIVE STATICS ANALYSIS

In Chapter IV, we have shown by equation (50) the first-order condition for the objective function:

$$\partial EU/\partial N = U_0'(-\partial RP/\partial N) + E_{13}[U_1'(S'-F'-Q')(\partial I_0/\partial N)] = 0,$$

since $U_0'(-\partial RP/\partial N) < 0$, it follows that

$$E_{13}[U_1'(S'-F'-Q')(\partial I_0/\partial N)] > 0. \tag{C1}$$

Let

$$- U_1''/U_1' = R_A > 0,$$

where R_A denotes the Pratt-Arrow's measure of absolute risk aversion. Rearranging terms,

$$- U_1'' = R_A U_1',$$

multiplying each side by $(S'-F'-Q')(\partial I_0/\partial N)$ we obtain

$$-U_1''(S'-F'-Q')(\partial I_0/\partial N) = R_A U_1'(S'-F'-Q')(\partial I_0/\partial N),$$

or

$$U_1''(S'-F'-Q')(\partial I_0/\partial N) = -R_A U_1'(S'-F'-Q')(\partial I_0/\partial N).$$

taking expectation on both sides,

$$E_{13}[U_1''(S'-F'-Q')(\partial I_0/\partial N)] = -R_A E_{13}[U_1'(S'-F'-Q')(\partial I_0/\partial N)],$$

since $R_A > 0$ and $E_{13}[U_1'(S'-F'-Q')(\partial I_0/\partial N)] > 0$, then

$$E_{13}[U_1''(S'-F'-Q')(\partial I_0/\partial N)] < 0. \qquad (C2)$$

Given the first-order condition and denote the second-order condition by H (H < 0 for the maximization problem of the theoretical model), we can derive hypotheses about the relationships between the allocation ratio and the relevant exogenous variables; that is, the signs of the following partial derivatives can be determined from the comparative statics analysis:

$$\partial N/\partial y = -(1/H)EU_{Ny}$$
$$\partial N/\partial e = -(1/H)EU_{Ne}$$
$$\partial N/\partial w = -(1/H)EU_{Nw}$$
$$\partial N/\partial i = -(1/H)EU_{Ni}$$
$$\partial N/\partial k = -(1/H)EU_{Nk}$$
$$\partial N/\partial T = -(1/H)EU_{NT}$$

where the subscripts denote the respective cross partial derivatives of the expected utility function. Since $-(1/H)$ is positive, the sign of the relationship between the allocation ratio and each of the exogenous variables depends on the direction of the cross partial derivatives of the expected utility.

D.1   THE ISSUE SIZE AND THE ALLOCATION RATIO

$$\partial N/\partial y = -(1/H)EU_{Ny}$$

$$= -(1/H)\{E_{13}[U_1''(S'-F'-Q')(\partial I_0/\partial N)(-\partial S/\partial y-\partial F/\partial y)]$$

$$+ E_{13}[U_1'(\partial S'/\partial y-\partial F'/\partial y)(\partial I_0/\partial N)]$$

$$+ U_1'(S'-F'-Q')(\partial I_0/\partial N)f(X_3)(\partial X_3/\partial y)$$

$$- U_1'(S'-F'-Q')(\partial I_0/\partial N)f(X_1)(\partial X_1/\partial y)\}.$$

Since $\partial I_0/\partial N = 0$ at X , the last term in the RHS vanishes.

By equation (C1), (C2) and the assumptions in Section 4.1

(i.e., $\partial S/\partial y > 0$ and $\partial F/\partial y > 0$), the first term in the RHS

must be positive. In addition, it can be shown that the

third term is also positive, since $U_1'(S'-F'-Q')(\partial I_0/\partial N) > 0$

at X_3 and $\partial X_3/\partial y > 0$.[22] Therefore, the sign of $\partial N/\partial y$ depends

on the second term:

If $|\partial S'/\partial y| > |\partial F'/\partial y|$, then all terms are positive and

   $\partial N/\partial y > 0$.

---

[22] Recall from Section 3.5 that
   $Q' = G = NR(N,X_3)/P_S = P_0/P_S -1$,
furthermore,
   $P_1(n_0+n_1) = X_3-costs$
or $P_1 = (X_3-costs)/(n_0+n_1)$.
substituting P_1 into G,
   $(X_3-costs)/(n_0+n_1)P_S = Q'+1$
or
   $X_3 = (Q'+1)(n_0+n_1)P_S + costs$
       $= I(Q'+1)(1+N)+F(I)+C(I_i=0)+S(0)+Q(I_0=I)$
Thus $\partial X_3/\partial y = \partial F/\partial y + \partial S/\partial y > 0$.

If $|\partial S'/\partial y| < |\partial F'/\partial y|$, then the direction of $\partial N/\partial y$ is ambiguous.

D.2   THE RISKINESS OF THE STOCK AND THE ALLOCATION RATIO

$$\partial N/\partial e = -(1/H)EU_{Ne}$$
$$= -(1/H)[U_0''(-\partial RP/\partial e)(-\partial RP/\partial N)+U_0'(-\partial^2 RP/\partial N\partial e)] < 0.$$

That is, ceterus paribus, the allocation ratio decreases as the riskiness of the stock increases.

D.3   THE OWNERSHIP CONCENTRATION AND THE ALLOCATION RATIO

$$\partial N/\partial w = -(1/H)EU_{Nw}$$
$$= -(1/H)\{E_{13}[U_1''(S'-F'-Q')(\partial I_0/\partial N)(-\partial F/\partial w - \partial Q/\partial w)$$
$$+U_1'(-\partial F'/\partial w - \partial Q'/\partial w)(\partial I_0/\partial N)]$$
$$+ U_1'(S'-F'-Q')(\partial I_0/\partial N)f(X_3)(\partial X_3/\partial w)$$
$$- U_1'(S'-F'-Q')(\partial I_0/\partial N)f(X_1)(\partial X_1/\partial w)\}.$$

From the assumptions in Section 4.1 and equation (C2), it is straight forward to demonstrate that the first term in bracket is negative. In addition, following a similar approach as before (see footnote 22), it can be shown that

$$\partial X_3 / \partial w = \partial F / \partial w + \partial Q / \partial w < 0$$

hence the second term is also negative. Finally, since the last term equals zero, the relationship between the ownership density and the allocation ratio is unambiguously negative,

$$\partial N / \partial w < 0.$$

D.4   THE INTEREST RATE AND THE ALLOCATION RATIO

$$
\begin{aligned}
\partial N / \partial i = & -(1/H) EU_{Ni} \\
= & -(1/H)\{ [U_0''(-\partial RP/\partial i)(-\partial RP/\partial N) + U_0'(-\partial^2 RP/\partial N \partial i)] \\
& + E_{13} [U_1''(S'-F'-Q')(\partial I_0/\partial N)(-\partial Q/\partial i) \\
& \quad + U_1'(-\partial Q'/\partial i)(\partial I_0/\partial N)] \\
& + U_1'(S'-F'-Q')(\partial I_0/\partial N) f(X_3)(\partial X_3/\partial i) \\
& - U_1'(S'-F'-Q')(\partial I_0/\partial N) f(X_1)(\partial X_1/\partial i)\}.
\end{aligned}
$$

The first term registers the marginal impact of interest rate on N through the risk premium function, which is clearly negative; the rest of terms are the marginal impact of interest rate on N through the owner's subscription cost

_____

[23] As before, the sign of $\partial X_3 / \partial i$ are determined as follows

function, which is positive.[23] Thus, if the impact of
interest rate on the owner's subscription cost dominates the
impact of interest rate on the risk premium, the relation-
ship between the interest rate and the allocation ratio will
be positive, that is

$\partial N/\partial i > 0$.

If the increase in N due to risk premium increase dominates,
the relationship will be reversed and

$\partial N/\partial i < 0$.

D.5 THE CAPITAL MARKET VARIABLE AND THE ALLOCATION RATIO

$$\partial N/\partial k = -(1/H)EU_{Nk}$$
$$= -(1/H)\{E_{13}[U_1''(S'-F'-Q')(\partial I_0/\partial N)(-\partial S/\partial k)]$$
$$+ E_{13}[U_1'(\partial S'/\partial k)(\partial I_0/\partial N)]$$
$$+ U_3'(S'-F'-Q')(\partial I_0/\partial N)f(X_3)(\partial X_3/\partial k)$$
$$- U_1'(S'-F'-Q')(\partial I_0/\partial N)f(X_1)(\partial X_1/\partial k)\}.$$

$\partial X_3/\partial i = \partial Q/\partial i > 0$.
Thus, the third term in the RHS of $\partial N/\partial i$ is positive.

We will first discuss the case when $\partial S/\partial k > 0$ and $\partial S'/\partial k > 0$. In this case, the first term is positive while the second term is negative. The sign of the third term is positive since $\partial X_3/\partial k = \partial S/\partial k > 0$. Therefore, if the second term is the dominant factor, then the relationship between the capital supply variable and the allocation ratio will be negative,

$$\partial N/\partial k < 0.$$

When $\partial S/\partial k < 0$ and $\partial S'/\partial k < 0$, all signs will be reversed and

$$\partial N/\partial k > 0,$$

if the second term dominates.

D.6   THE TRANSFER COST VARIABLE AND THE ALLOCATION RATIO

$$
\begin{aligned}
\partial N/\partial T &= -(1/H)EU_{NT} \\
&= -(1/H)\{E_{13}[U_1''(S'-F'-Q')(\partial I_0/\partial N)(-\partial F/\partial T) \\
&\qquad\qquad +U_1'(-\partial F'/\partial T)(\partial I_0/\partial N)] \\
&\qquad + U_1'(S'-F'-Q')(\partial I_0/\partial N)f(X_3)(\partial X_3/\partial T) \\
&\qquad - U_1'(S'-F'-Q')(\partial I_0/\partial N)f(X_1)(\partial X_1/\partial T)\}.
\end{aligned}
$$

From equation (C2) and the assumptions made in Section 4.1 (i.e., $\partial F/\partial T > 0$ and $\partial F'/\partial T > 0$), it is apparent that the first term in the brackets is positive. In addition,

$$\partial X_3/\partial T = \partial F/\partial T > 0,$$

so the second term is also positive. Therefore, the relationship between the allocation ratio and the transfer cost variable is unambiguously positive,

$$\partial N/\partial T > 0.$$

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A THEORETICAL AND EMPIRICAL ANALYSIS OF THE DETERMINATION OF THE ALLOCATION RATIO IN STANDBY UNDERWRITTEN RIGHTS OFFERINGS

by

Tai Ma

(ABSTRACT)

In this study the irrelevance school of issue price is challenged and a theoretical model of optimal allocation ratio which explicitly takes into account various costs associated with rights offerings is developed.

The empirical results reveal the importance of owners' subscription cost, the issuing firm's dividend policy, as well as the cost of administering share transfers in the determination of allocation ratio. The entirety of these results points, therefore, to the rejection of the irrelevance school of issue price and lend support to the three relevance school theories: the dividend policy cost theory of Levy and Sarnat, the transfer cost hypothesis of Beranek, and the cost of owner subscription hypothesis developed in this study.